Exploration Overview 1988

Northwest Territories

Mining, Exploration and Geological Investigations

March 1989

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PART 1: EXPLORATION AND MINING OVERVIEW 1988

INTRODUCTION

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Geology Division, INAC

Mine development and mineral exploration performed well in NWT during 1988. Due mainly to flowthrough financing, exploration continued at a healthy pace. One major operation started up, another closed down and four or five more projects are moving towards production.

MINE DEVELOPMENT AND ADVANCED EXPLORATION

Seven NWT mines were in production during 1988. **NERCO-Con, Giant Yellowknife** and **Ptarmigan** at Yellowknife and **Lupin** on Contwoyto Lake all produced gold. **Polaris, Nanisivik** and **Pine Point** produced lead and zinc concentrates. Pine Point milled its last ore on April 6, and the town is being dismantled. Mine development or advance exploration was underway on eight properties.

The most important mining development of 1988 was the commissioning of **Giant Yellowknife Mines** tailings recycling plant. Built at a cost of $25 million which included $1 million for a pilot plant and $8 million for a new tailings pond, it will process 7,300 t/day recovering about half of the 2.3 g/t of contained gold.

Urangesellschaft continued exploration, feasibility studies, and planning, and sought regulatory approvals for its Kiggavik uranium development west of Baker Lake. This deposit, 2.99 Mt at 0.61% U_3O_8, is at least as big as the Rabbit Lake deposit, the first unconformity-hosted uranium deposit in Canada to be mined.

Neptune Resources is constructing a 10,000 t/day mining plant to service an open pit mine on the Colomac Dyke gold deposit just north of Indin Lake (212 km north-northwest of Yellowknife). Supplies and equipment were brought to the site in spring 1988 by the winter road at a cost of $10 million. Total construction and pre-production costs will be $121 million. Operating costs are expected to be $14.74/t. This operation should be tuning up early in 1990.

In November, **Treminco Resources** poured the foundation for a head frame at its Ptarmigan Mine site (15 km northeast of Yellowknife); Treminco continued mining and underground development at Ptarmigan and underground exploration at the nearby, but much smaller, Tom deposit.

Noranda-TOTAL Energold is continuing a $30 million underground test of the Tundra deposit which lies just north of Salmita (240 km northeast of Yellowknife). The shaft should reach the planned 480 m depth by mid-February. This huge deposit, 29.5 Mt of 6.9 g/t Au, is the first gold deposit found in felsic volcanics in NWT.

The Back River Joint Venture is in its sixth year of extensive exploration of iron formation hosted gold deposits in the Beechey Lake turbidite basin (east of the Hackett River and 505 km northeast of Yellowknife). Expenditures on this project have probably exceeded $1 million per year for the last five years. Such a level of effort and expenditure suggests a significant discovery.

Highwood-Hecla continue to explore and research products and market potential for their world class Thor Lake beryllium REE deposits in the Blatchford Lake alkaline intrusion. Not only is the T-zone at Thor Lake the first beryllium deposit to have phenacite as the dominant ore mineral, it is reportedly the largest and richest beryllium deposit ever found.

Drilling continued during most of 1988 at **Aber Resources' - Hemisphere Development's** volcanogenic silver base metal deposit on Sunrise Lake, in the Beaulieu River Volcanic Belt (112 km east-northeast of Yellowknife). Threshold tonnage for a silver-base metal mine at Sunrise, about 65 km from the end of the NWT highway system, is in the order of 3 Mt of material grading 411 g/t Ag.

Other companies, **Noranda, Silver Hart - Ark La Tex** have intersected similar mineralization on nearby claims. Deposits of similar silver-rich material were explored to the south in the Tumpline-Turnback Lake area 30 years ago.

MINERAL EXPLORATION

Exploration appears to have increased and become more widespread in NWT during 1988. Although there were more projects in 1988, and more of them involved drilling, there was, overall, a reduction of nearly 30,000 m of exploration drilling in 1988 compared to 1987 (Table 1) and as a result, expenditures on exploration were down slightly from the $90 million that the NWT Chamber of Mines estimates was spent in 1987. That figure is reasonably accurate because it was obtained through an intensive telephone survey of companies active in the NWT.

A comparison of activity levels in the various geological provinces and subprovinces (Table 2) shows a significant increase in properties worked in the Keewatin, southeast Mackenzie and Bear Provinces. Most of the properties are PGE prospects.

Nevertheless, exploration expenditures probably exceeded $70 million for the second year in a row. Interest in Prospecting Permits was intense but because of widespread exploration in or adjacent to many of the areas for which permits were applied, only 45 Prospecting Permits were issued.

As block staking is allowed in NWT, a claim may vary from 20 to 1000 ha. Thus, numbers of claims staked or lapsed (Table 3) means nothing without knowing the area covered by the claims. During 1988, 1098 claims covering 739,928 ha were staked and 4448 claims covering 464,348 ha lapsed.

At the end of December, 1988, 16,702 claims in good standing in NWT covered 3,115,083 ha.

The net result of claim staking and claim lapsing during 1988 was that 3,350 fewer claims were existent but they covered 275,580 more hectares of land.

Staking increased in the Slave Province by 14% and in the Keewatin by 193% from 1987 (Table 4). Staking in the Bear Province decreased by 81% in 1988.

TABLE 1: SUMMARY OF DIAMOND DRILLING IN THE NWT, 1986-88

compiled by M. Rogers

BY DISTRICT	1986	1987		1988*
Franklin (Arctic Islands)	38,866.5	28,504.0		25,988.1
Keewatin	20,622.8	32,867.6		38,107.9
Mackenzie	108,322.6	128,868.5		121,333.6
BY GEOLOGICAL PROVINCE				
Slave	78,047.9	108,716.8		112,943.2
Bear	1,555.0	3,169.2		8,390.5
Churchill	46,904.3	46,964.5	Rae	9,550.9
			Hearne	28,556.4
Cordilleran	--	244.5		--
Interior Platform	26,660.2	15,348.2		15,466.8
Innuitian	10,044.5	15,797.0		10,521.8
BY COMMODITY				
Uranium	13,443.7	8,664.1		9,516.9
Base Metals	60,526.7	43,852.2		53,157.5
Precious Metals	85,226.9	133,164.7		113,524.4
Tungsten and Rare Metals	1,325.6	--		3,519.5
Platinum Group Elements	2,288.9	4,559.1		5,711.3
SURFACE DRILLING	119,961.5	140,101.1		140,393.1
UNDERGROUND DRILLING	42,850.4	50,138.9		45,036.5
TOTAL DRILLING	162,811.9	190,240.1		185,429.6

*data as of February 22, 1989

TABLE 2: COMPARISON OF ACTIVITY IN VARIOUS GEOLOGICAL PROVINCES AND SUBPROVINCES

GEOLOGICAL		NUMBER OF PROJECTS EACH YEAR										
Region	Year	78	79	80	81	82	83	84	85	86	87	88
Cordillera		14	21	29	24	12	11	11	7	4	2	1
Arctic Islands *		8	4	7	24	16	11	17	13	6	1	2
Keewatin **		36	48	53	59	34	25	19	17	21	17	33
SE-Mackenzie ***		7	13	14	25	10	11	9	3	1	6	13
East Arm		7	6	4	14	3	1	1	2	1	4	4
Pine Point		7	5	6	6	3	2	1	2	1	1	11
Bear Province		32	32	22	24	10	11	2	3	6	3	11
Slave Province		29	33	29	42	25	44	57	92	90	89	93
Totals:		**140**	**162**	**164**	**218**	**113**	**116**	**117**	**139**	**130**	**123**	**157**

* Includes Baffin Island and Melville Peninsula, part of the Churchill Province, as well as the Arctic Archipelago
** Churchill Structural Province
*** Churchill Province in District of Keewatin

Table 3: MINERAL CLAIMS IN THE NWT, 1983 to 1988

Year	Claims (Hectares) Recorded	Cancelled	Good Standing
1983	547 (330,592)	5424 (703,289)	40,952 (3,114,606)
1984	488 (240,900)	4222 (472,323)	36,528 (2,878,225)
1985	461 (294,887)	6565 (455,237)	30,398 (2,704,790)
1986	531 (360,361)	5655 (339,468)	25,266 (2,721,985)
1987	843 (552,385)	6031 (430,657)	20,052 (2,829,403)
1988	1098 (739,928)	4448 (464,348)	16,702 (3,115,083)

Prospecting permits were taken out on 45 areas in 1988, a major increase over the 6 permits issued in 1987. Most (37) were in the Keewatin District (Churchill Structural Province), the remainder (8) were in the northern Slave Province. Gold is believed to be the major target commodity in all permit areas. Table 5 shows the distribution of prospecting permits issued in the NWT in the last decade.

Diamond drilling was down by 21% from 1987, though not all drilling will have been reported (Table 1) at the time of writing. At least 155 properties were explored this year and 55 of these were diamond drilled. Only 117 properties were explored including 63 drilled in 1987. The search for gold, still the number one target commodity, continued to spread to areas beyond the Slave Province (Table 6) including the East Arm Fold Belt, Nonacho Basin

TABLE 4: GROUND STAKED BY GEOLOGICAL PROVINCE, 1985 TO 1988

Geological Area	(Thousands of hectares) Year 1985	1986	1987	1988
Arctic Islands	0.5	1.0	0	0
Keewatin	49.9	71.9	88.9	260.6
SE Mackenzie	8.7	1.02	1.9	22.0
Slave	231.3	209.5	372.4	423.5
East Arm	0.1	5.7	0.6	23.6
Bear	1.2	67.2	67.1	12.7
Pine Point	0	67.2	0.2	0
Cordillera	1.8	0	0.8	1.8
TOTALS	293.5	423.5	551.0	744.2

and adjacent parts of the Rae and Hearne Provinces (northwest and southeast sub-divisions of the Churchill Province).

At least 50 gold properties were drilled and another 71 received less intensive exploration. Another 36 properties were explored for other metals, and 21 of these were drilled. Widespread reconnaissance of old uranium showings for their gold and PGM potential included work in the Wopmay Orogen, Kilohigok and Nonacho Basins, and generally throughout the Rae Province (northwest Churchill).

Lead-zinc exploration was confined to drilling around Nanisivik and Polaris Mines.

Uranium exploration was limited to three projects in the Bear Structural Province where one property was drilled, and five projects in the Keewatin District where development and exploration continued on and around the Kiggavik deposit. Three uranium prospects were drilled in the area west of Baker Lake.

TABLE 5: PROSPECTING PERMITS ISSUED 1978 TO 1988, IN VARIOUS GEOLOGICAL PROVINCES

AREA	YEAR 79	80	81	82	83	84	85	86	87	88
Arctic Island	0	10	2	53	87	10	15	3	0	0
Cordilleran Province	1	11	9	12	7	0	0	0	1	0
Churchill Province	72	57	54	17	1	10	11	26	5	37
Bear Province	26	17	4	3	0	0	5	2	0	0
Slave Province	0	3	4	6	1	5	22	0	0	8
TOTALS:	**99**	**98**	**73**	**91**	**96**	**25**	**53**	**31**	**6**	**45**

TABLE 6: 1988 EXPLORATION PROJECTS IN THE NWT BY GEOLOGICAL REGION

Commodity:	Gold	Uranium	Silver Base Metals	PGE	Rare & other metals	Total Exploration	MINES operating	MINES developing
AREA								
Slave Province	(46) 43	- -	(4) -	- -	- -	(50) 43	4 Au	2 Au
Keewatin (Rae & Hearne)	(7) 18	(3) 1	- -	(1) 3	- -	(11) 22	-	2 Au, U
SE Mackenzie (Rae)	- 4	- -	- -	- 9	- -	- 1	-	-
Bear Province (Wopmay & Kilohigok)	- -	(1) 2	(1) -	(2) 5	- -	(4) 7	-	-
(East Arm)	(1) 1	- -	- -	- -	(1) 1	(2) 2	-	1 Be
Cordillera	- 1	- -	- -	- -	- -	- 1	-	-
Arctic Islands	- -	- -	(2) -	- -	- -	(2) -	3 Pb-Zn	-
Totals	(54) 67	(4) 3	(7) -	(3) 17	(1) 1	(69) 76	7	5

Numbers in brackets indicate the number of exploration projects with diamond drilling;
Numbers without brackets indicate the number of exploration projects without diamond drilling.

The silver potential of volcanogenic massive sulphides was explored by three drill projects in the Beaulieu River volcanic belt around Aber's Sunrise deposit and by one drill project in the Clinton-Colden Lake area. A silver property was drilled in the Bear Magmatic Zone around Bonanza and El Bonanza on Great Bear Lake.

In the East Arm exploration continued on the Lake Zone Ta-REE deposit in the Blatchford Lake alkaline complex. As well, one barite showing was sampled and the Fox Mine, a 1940s Au-Cu-WO_3 producer on the Outpost Islands, was drilled. Two gold showings east of the Fox Mine were prospected and staked.

Two gold showings, in the Rae Province (northwestern Churchill) south of the East Arm, were also worked.

Platinum was, after gold, the most sought material with 13 projects underway. Seven of these were in the Bear Province including: three on parts of the Muskox Intrusion; and, two on what are thought to be Coronation Hill type targets, one northeast of Port Radium, and one in the Bathurst trench. Staking and testing of uranium showings for PGM and gold covered seven properties southeast of Great Slave Lake and four in the Keewatin District; three in the Rae Province (northwestern Churchill), and one in the Hearne Province (southwestern Churchill).

The Archean Slave Structural Province was still the main area of gold exploration with 43 properties drilled and another 46 explored without drilling. Exploration projects of major proportions were executed by: **Chevron Canada Resources** in the northern Slave on property optioned from Silver Hart; the **Back River Joint Venture** east of the Hackett River; and **Noranda-TOTAL Energold** (Tundra Project) immediately north of the recently closed Salmita Mine. A multitude of smaller programs tested claims adjacent to the Tundra Project area; claims south, west and east of the Lupin Mine; claims in the Indin Lake volcanic belts; claims in the Back River, Russell-Slemon Lakes area, and in the volcanics and sediments throughout the Yellowknife Supracrustal Basin.

In the Keewatin, twenty-four gold showings in the Hearne Province were explored; six of these showings were drilled. In the Rae Province one of two properties explored was drilled.

Borealis continued its attempts to develop a high grade, low tonnage operation on gold bearing veins in the Tavani area of the Keewatin (about 70 km southwest of Rankin Inlet). Extensive drilling took place on nearby properties of **Dejour Mines** and **Noble Peak Resources**, all in the Rankin-Ennadai volcanic belt of the Hearne Structural Province.

The **Canada-NWT Mineral Development Agreement** reached full stride. Thirty-one geoscience projects were underway, eighteen under Geological Survey of Canada auspices, twelve under NWT-based geological organizations, and one sponsored and funded jointly by GSC and NWT. Results of these projects are reported elsewhere in this review.

GEOLOGY DIVISION FIELD PROJECTS

Because of staff realignment and the requirements of providing technical direction to the NWT-MDA, NWT Geology Division projects were slightly reduced from the level of previous years.

Projects underway (Table 7) included detailed mapping in the Russell-Slemon Lake area by a crew of five, under our Project Geologist, reconnaissance in area 76L and M, and property investigations by four District Geologists. One District Geologist spent six weeks assisting one of the MDA mapping crews.

Only five contracts were let to university professors as compared to nine in 1987. These contracts are listed in the Table 8.

TABLE 7: GEOLOGY DIVISION MAPPING PROJECTS, 1988

OFFICER	PROJECT
V. Jackson	Mapping (1:30 000 scale) Russell and Slemon Lakes area (85 O/4)
V. Jackson	Geological checking in 76K and 76M for 1:50 000 and 1:250 000 scale mapping
W.A. Gibbins	Mapping 1:50 000 lower Hope Bay Volcanic Belt (with J.Gebert NWT-MDA)
J.B. Seaton	Mapping (1:10 000) in the Tibbet Lake area (85I/11,14)

TABLE 8: 1988-89 University Contracts

Professor (student)	*University*	*Project*
J.A. Donaldson (Hendrick Falck, M.Sc.)	Carleton University	Conduct detailed mapping of the volcanic and sedimentary rocks in the Giant Section and relate the results of this work to other units in the Yellowknife volcanic belt.
W.S. Fyfe (David Atkinson, Ph.D)	University of Western Ontario	Study of the Western Plutonic complex and determine its relevance to shear zone hosted gold deposits at Yellowknife.
N.W. Rutter (Dan Kerr, Ph.D)	University of Alberta	Map and study Quaternary sediments along the Arctic Coast of the NWT (Paulatuk to Cape Barron)
S.A. Bowring (Clark Issachsen, Ph.D)	Washington University of St. Louis	Geochronological studies in the Slave Province and mapping related to geochronological sampling.
P. Cerny (Michael Wise, Paul Tomascak, Ph.D)	University of Manitoba	Map and study rare element pegmatites in the Chantrey Inlet area.

CANADA-NWT MINERAL DEVELOPMENT AGREEMENT

Martin Irving
Canada-NWT Mineral Development Agreement

The Canada-Northwest Territories Mineral Development Agreement (MDA) comprises three programs: Geoscience, Northern Technology Assistance (NTAP) and Northern Mining Information (NMIP).

The Agreement is administrated by a management group of W. Padgham (DIAND), Pierre Alvarez (GNWT), Al Clark (EMR Canada) and Kit Spence (GNWT); A. Redshaw (DOE) is an *ex-officio* member. The management group reviews and approves all applications.

Thirty-one Geoscience projects were undertaken; most are multi-year projects. The GNWT manages 12 projects (Table 9), the GSC manages 18 (Table 10), and one is jointly sponsored. Funds available for the Geoscience program for 1988/89 are $1.48 million. The MDA Geoscience projects are shown on Figure 1.

After a slow start, the interest in NTAP has picked up. CANMET, in Ottawa is helping the MDA Management Group to coordinate the various projects. This year $110 thousand will be spent assisting northern mining operators adapt technology to the northern environment.

NMIP has funds of $88 thousand and will implement eight projects ranging from newsletters to radio interviews and maps for schools. The objective is to increase the awareness of NWT residents of the importance of the mining industry and of the many opportunities available in this industry.

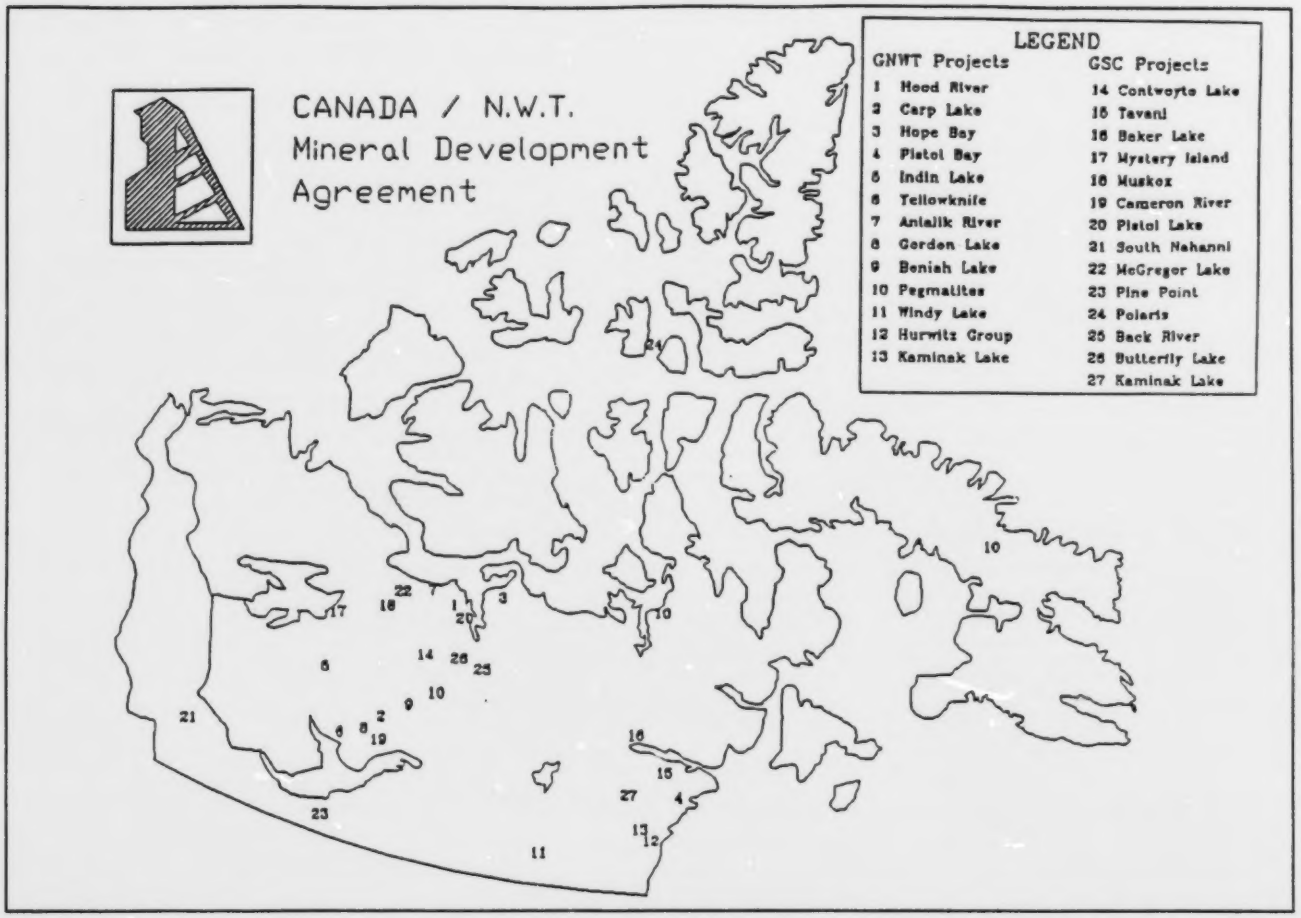


FIGURE 1: MDA PROJECTS IN THE NWT, 1988.

TABLE 9: Canada - NWT Mineral Development Agreement, GNWT Projects

GNWT Staff	Map Number (Figure 1)
Lower Hood - James River: R. Johnstone	1
Carp Lake - Tundra: M. Stubley	2
Hope Bay: J. Gebert	3
Mistake Bay - Pistol Bay: S. Goff	4
Indin Lake: J. Morgan	5
Yellowknife: D. Atkinson	6

Contractors	Map Number (Figure 1)
Anialik River: E. Spooner/A. Abraham, University of Toronto	7
Gordon Lake: M. Zentilli/T. Stokes, Dalhousie University	8
Beniah Lake: W. Fyson/D. Roach, University of Ottawa	9
South Slave Pegmatites: P. Cerny/M. Wise, University of Manitoba	10
Kiyuk-Windy Lakes: L. Aspler (joint project with GSC)	11
Hurwitz Group: J. Patterson, University of Toronto	12
Kaminak Lake: H. Baadsgaard/P. Cavell, University of Alberta	13

Table 10: Canada - NWT Mineral Development Agreement, GSC Projects

Regional Geology	Map number (Figure 1)
Contwoyto-Nose Lake area: J. King/C. Relf	14
Tavani Greenstone Belts: S. Tella	15
Baker Lake - Mapping and Geochemistry: A. LeCheminant/J. Roddick	16
Mystery Island Intrusive Suite: R. Hildebrand	17
Muskox Intrusion Border Zone: W. Baragar	18
Cameron River Greenstone Belt: M. Lambert	19
Quaternary Geology and Geochemistry:	
Gold and PGE in till - Churchill/Slave: W. Coker	26
Gold and PGE/rare metals in till - Kaminak Lake W. Shilts	27

Mineral Deposits	Map number (Figure 1)
Gold Metallogeny-Slave Province: C. Jefferson	20/2?
Gold Metallogeny - Churchill Province: A. Miller	Various
South Nahanni Tungsten, rare metals: C. Jefferson	21
PGE in ultramafic-mafic rocks: L. Hulbert	22
Rare metals, Slave, Churchill, Bear Provinces: W. Sinclair	Various
Pine Point/Polaris Geology: D. Sangster	23/24
Clay Mineralogy/Uranium Churchill/Bear: A. Miller	Various
Exploration Geophysics	
Aeromagnetic Survey D.Teskey.	Various
Airborne Geophysical Surveys B. Charbonneau	Various

OPERATING MINES

Carol E. Ellis

Four gold mines and three lead-zinc mines were operating in the Northwest Territories in 1988 (Fig. 2). The value of mineral production for 1988 is estimated to be $560 million (Table 11); production estimates are listed in Table 12.

GOLD

NERCO-Con Mine, after adding 11,600 kg of gold to its reserves by re-evaluating data for Con shear zone, is rehabilitating and developing these workings for production. The Con head frame, which had been used for ventilation and as a secondary escape route in recent years, was torn down in early August. A new head frame was finished by the end of the year.

Giant Mine's tailings 're-treatment' plant, built during the winter, reached full capacity (7300 t/day) three weeks after start up at the beginning of May. Tailings reserves are estimated to be 6.4 Mt containing 2.3 g/t gold. The plant is designed to operate from May to the end of October, but in its first year of production it was shut down because of cold weather on October 21 after processing almost 1 Mt of tailings. With 5.8 Mt material to treat, this new "mining plant" has an expected life of six years and should contribute 6220 kg of gold to Giant's overall production.

Ptarmigan Mine was brought into production on April 1. The first two levels are accessible by a decline; a head frame is being built and a hoist will be installed by year end to access the third level and below. **Tremlnco Resources** is seeking regulatory approval to build a mill that would process ore from both Ptarmigan and Tom mines. **Tom Mine** was re-opened in July. A decline is being driven to the second level; exploration from the second level is planned.

At **Lupin Mine**, exploration drilling from the 250 m level tested the West zone. A shaft deepening project started in September; a depth of 890 m will be attained by February 1989.

LEAD-ZINC

Pine Point Mines Ltd. milled stockpiled ore during the first quarter; milling ceased on April 6. Most of the mine equipment has been sold. The town of Pine Point officially closed on September 1, 1988.

Approximately 50% of the mill feed at **Nanisivik Mine** came from the Main lens, the remainder came from the lower lens and Shale Hill. Because of high zinc prices, only zinc concentrate was shipped this year.

At **Polaris Mine**, the Keel zone continued to be developed and mined.

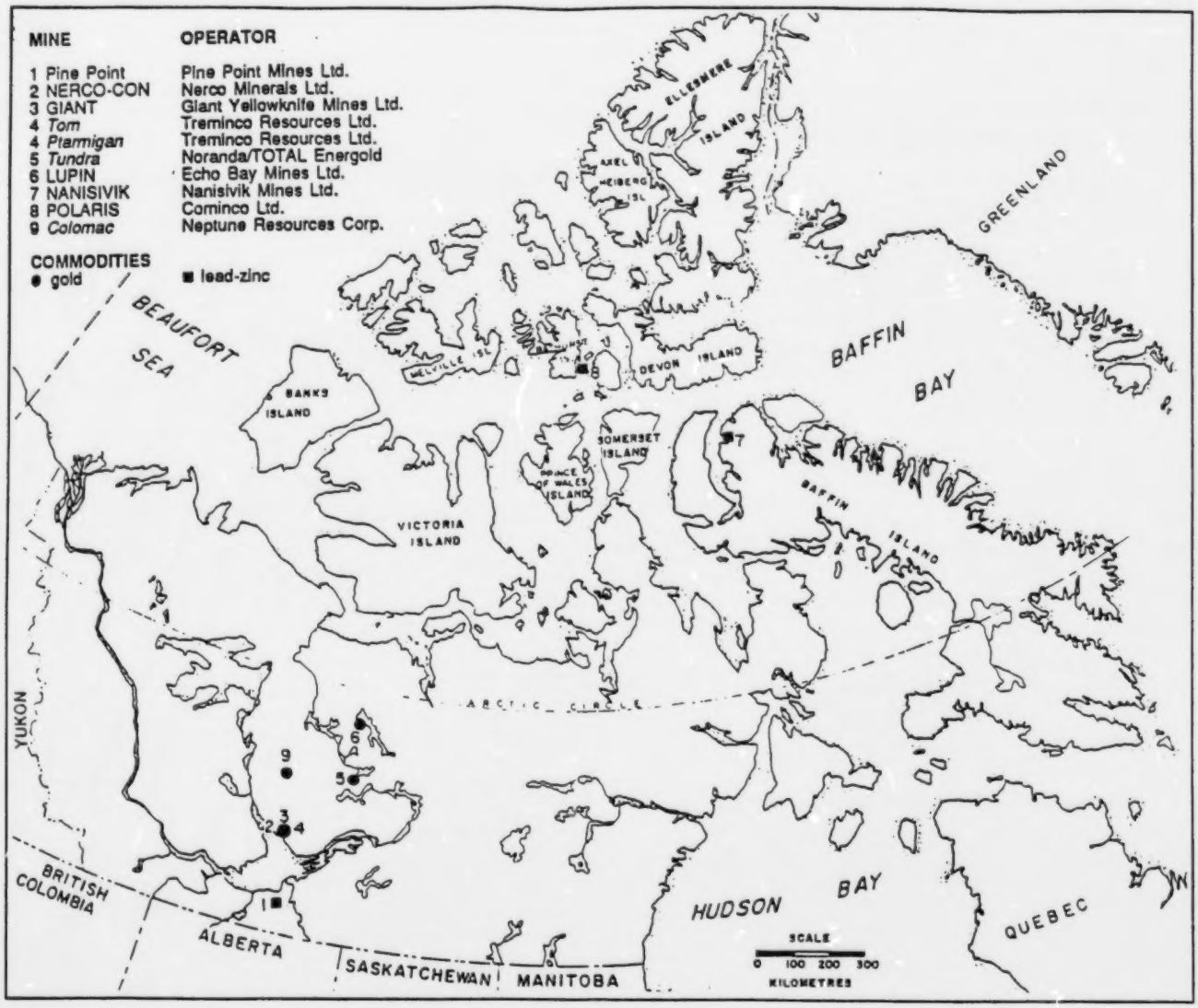


FIGURE 2: MINES OPERATING IN THE NWT DURING 1988. Names in italics indicate deposits being developed for production; names in lower case indicate the mine closed in 1988.

TABLE 11: VALUE OF MINERAL PRODUCTION IN THE NWT, 1985 TO 1988

YEAR	Gold(kg)	Silver(kg)	Lead(kt)	Zinc(kt)	Value* ($ million)
1985	13,014	33,039	96.6	344.4	$722
1986	12,233	27,899	138	417.2	$780
1987	12,280	25,218	151	479.3	$843
1988	11,834	24,234	65.1	292.3	$560

*Values for 1984 and 1985 include estimate for tungsten.

Source for metal prices: Northern Miner.

TABLE 12: ESTIMATED PRODUCTION FROM OPERATING MINES, 1988

Mine	Commodity	Ore milled*1 1987	Production*1 1987	Reserves*1 Dec.31, 1987	Ore milled*2 1988	Production*2 1988
NERCO-Con	gold	192 kt*3	2576 kg Au *3		194 kt	2425 kg Au 485 kg Ag
Giant	gold	339 kt	2382 kg Au	2419 kt 8.54 g/t Au	324 kt	2683 kg Au 561 kg Ag
Ptarmigan	gold	--	--	126 kt 12.33 g/t Au	28 kt	429 kg Au
Lupin	gold	613 kt	6006 kg Au	3397 kt 11.38 g/t Au	652 kt	6297 kg Au 1018 kg Ag
Pine Point	zinc, lead	3188 kt	288 kt Zn 114 kt Pb	--	888 kt*4	130 kt Zn*4 1.4 kt Pb*4
Nanisivik	zinc, lead, silver	679 kt	57.9 kt Zn 2.5 kt Pb 23 t Ag	2572 kt 10.1% Zn, 0.3% Pb,	678 kt	63 kt Zn 1.8 kt Pb 22 t Ag
Polaris	zinc, lead	3188 kt	129 kt Zn 27 kt Pb	15,060 kt 14.4 % Zn 3.9 % Pb	1013 kt	147 kt Zn 36 kt Pb

sources:
*1 company annual reports unless otherwise indicated.
*2 estimate based on monthly production figures submitted to the Mines Inspection Division, GNWT.
*3 communication with mine staff.
*4 Pine Point Mines Ltd. 2nd Quarterly Report.

ARCTIC ISLANDS REGION

Walter A. Gibbins

Cominco Ltd. drilled near the Polaris Mine on Little Cornwallis Island (8, Fig. 2).

Nanisivik Mines Ltd. continued to drill areas near the Nanisivik Mine, northern Baffin Island (7, Fig. 2).

CORDILLERAN DISTRICT

Arnold Enge

Liard River Exploration and Mining Company received a water license to dredge parts of the Liard River. The company experimented with recovery techniques for placer gold.

BEAR STRUCTURAL PROVINCE

James B. Seaton

Properties explored in 1988 are shown in Figure 3.

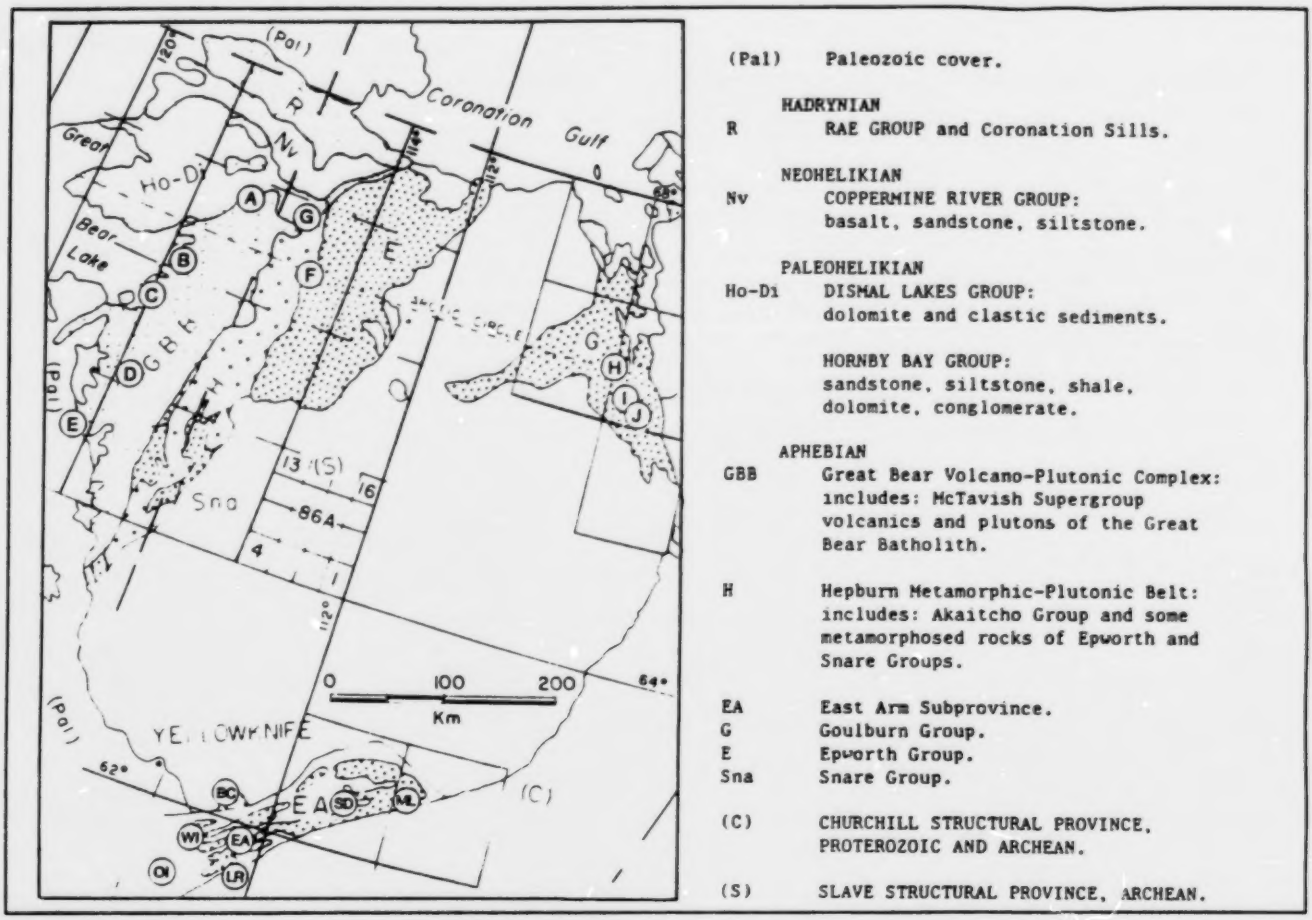
Aber Resources prospected the COREHILL claims (A) at the northern margin of the main body of the Great Bear Volcano-Plutonic Complex for platinum group metals. Geological mapping was done over a selected area. A parallel has been drawn between the COREHILL platinum group metals occurrence and the Coronation Hill deposit in Australia. **Aber's** partner in this venture is **Norgold Ltd.**

Aber Resources reconnoitred three large claim groups (H, I, J) in the Bathurst Inlet area. Here also the target was platinum group and/or precious metals potentially spatially related to an intra-Proterozoic unconformity.

CEGB Canada Exploration Ltd. drilled the "Damp" uranium-copper showing (D) at Longtom Lake on Prospecting Permit 1098 and explored an area to the south of Prospecting Permit 1099 and in the Beaverlodge Lake area (E). CEGB also explored the BULLWINKLE, BUD and CROSS claims in the Port Radium area (B) and reconnoitred a wider area of the northern Bear Province. The main target commodity was uranium.

Equinox Resources Ltd. in joint venture with **Technigen** explored the Muskox Intrusion. Grid layout and EM surveys (UTEM) were done on the VAL and SPEE claims (G), and the MUSK claims (F) that were staked on the feeder dyke of the intrusion south of the Coppermine River were reconnoitred. The target commodity in both areas was platinum group metals. Drilling was done on the SPEE 13 claim.

International Platinum Corporation explored the OX claims (G) at the Muskox Intrusion for platinum group metals. EM (UTEM) and magnetometer surveys, geological mapping and drilling were done.



(Pal) Paleozoic cover.

HADRYNIAN
R RAE GROUP and Coronation Sills.

NEOHELIKIAN
Nv COPPERMINE RIVER GROUP: basalt, sandstone, siltstone.

PALEOHELIKIAN
Ho-Di DISMAL LAKES GROUP: dolomite and clastic sediments.

HORNBY BAY GROUP: sandstone, siltstone, shale, dolomite, conglomerate.

APHEBIAN
GBB Great Bear Volcano-Plutonic Complex: includes: McTavish Supergroup volcanics and plutons of the Great Bear Batholith.

H Hepburn Metamorphic-Plutonic Belt: includes: Akaitcho Group and some metamorphosed rocks of Epworth and Snare Groups.

EA East Arm Subprovince.
G Goulburn Group.
E Epworth Group.
Sna Snare Group.

(C) CHURCHILL STRUCTURAL PROVINCE, PROTEROZOIC AND ARCHEAN.

(S) SLAVE STRUCTURAL PROVINCE, ARCHEAN.

FIGURE 3: MINERAL EXPLORATION IN THE BEAR PROVINCE, 1988

Octan Resources Ltd. drilled and trenched a property south of Port Radium (B) comprising their EL BONANZA claim and the BONANZA and other claims optioned from El Bonanza Mining Company Ltd. They acquired milling and other facilities from Terra Mines Ltd. including the Silver Bear, Norex and Smallwood Mines (C). The main target commodity was silver.

EAST ARM OF GREAT SLAVE LAKE

Walter A. Gibbins

Properties explored in 1988 are shown in Figure 3.

At Thor Lake (BC), the **Highwood Resources Ltd. - Hecla Mining Co.** joint venture drilled 2100 m in January to test the yttrium and rare earth potential of the Lake zone in the Blatchford Lake Complex. In September mapping and trenching tested possible southern extensions of this zone. Robert Pinckston, University of Alberta, continued mineralogical studies of the Lake zone; the joint venture continued marketing and metallurgical studies of beryllium from the T zone. The Geological Survey of Canada also continued petrological and geophysical surveys of the Blatchford Lake Complex.

The **Kelmet Resources - Comaplex Resources** joint venture explored Proterozoic rocks of the East Arm for unconformity and diatreme-related precious metal deposits (EA) and staked more than 24,300 ha.

William Kizan took a 300 kg sample of barite from the PEGGY K claim (SD) for testing.

In February, **Rapparee Resources Ltd.** drilled 10 holes (550 m) on the FOX claims (OI), Outpost Islands, the site of a gold-tungsten mine in the early 1940s.

Octan Resources Ltd. staked the GERRY claim to cover quartz veins at the west end of Wilson Island (WI).

Fred Loutitt staked the FRED and ERNIE claims near the mouth of the La Loche River (LR).

I. Hall staked the REX claims along the northwest side of Meridian Lake (ML).

SOUTHEASTERN MACKENZIE

Walter A. Gibbins

Properties explored in 1988 are shown in Figure 4.

NONACHO BASIN

Kelmet Resources Ltd. acquired PNC Canada Ltd. and Scurry-Rainbow Ltd. claims in the Nonacho Basin, explored the area for unconformity related U-Cu-Au-Ag-PGE targets and assessed the gold potential of quartz-pebble conglomerates in the Lower Nonacho Supergroup. **Kelmet Resources** also relogged core and staked additional ground at MacInnes Lake (MI).

Fortune Minerals Ltd. staked base metal showings at the north end of Salkeld Lake (SL) and tested them for gold.

Noranda Exploration Co. Ltd. explored the CREST claims near the southwest corner of Nonacho Lake (NR).

William Kizan staked the TET claim southwest of Nonacho Lake (NR). He also staked the NEY claim, a gold prospect near the north end of Nonacho Lake (NN).

RAE PROVINCE

Platinum Group Elements

The Stony Rapids Joint Venture operated by Trigg Woollett Olson Consulting Ltd. prospected and mapped mafic and ultramafic rocks near Thye, Opescal and Scott Lakes, 75 A/1-4 (TL, OL and SL).

Hartz Equities Inc. reconnoitred the ANKI claims at Thye Lake (TL), the SIMBA claim near Quinn Lake (QL) and the JUMBO claims north of Wholdaia Lake (WL).

Equinox Resources Ltd. explored the CANA claim north of Thomas Lake (EQ).

Gold

On behalf of **Courageous Exploration Ltd.** and **Norman Minerals Ltd.**, Taiga Consultants Ltd. did reconnaissance prospecting, soil geochemical surveys and VLF EM surveys on permits and claims optioned from Comaplex Resources International Ltd. and Tempest Exploration Ltd., in the Snowbird-Ennadai greenstone belt (CX).

W.A. Hubacheck Consultants Ltd. explored gossans associated with EM conductors for gold in the Rochon Lake area (AE) for Agnico Eagle Mines Ltd.

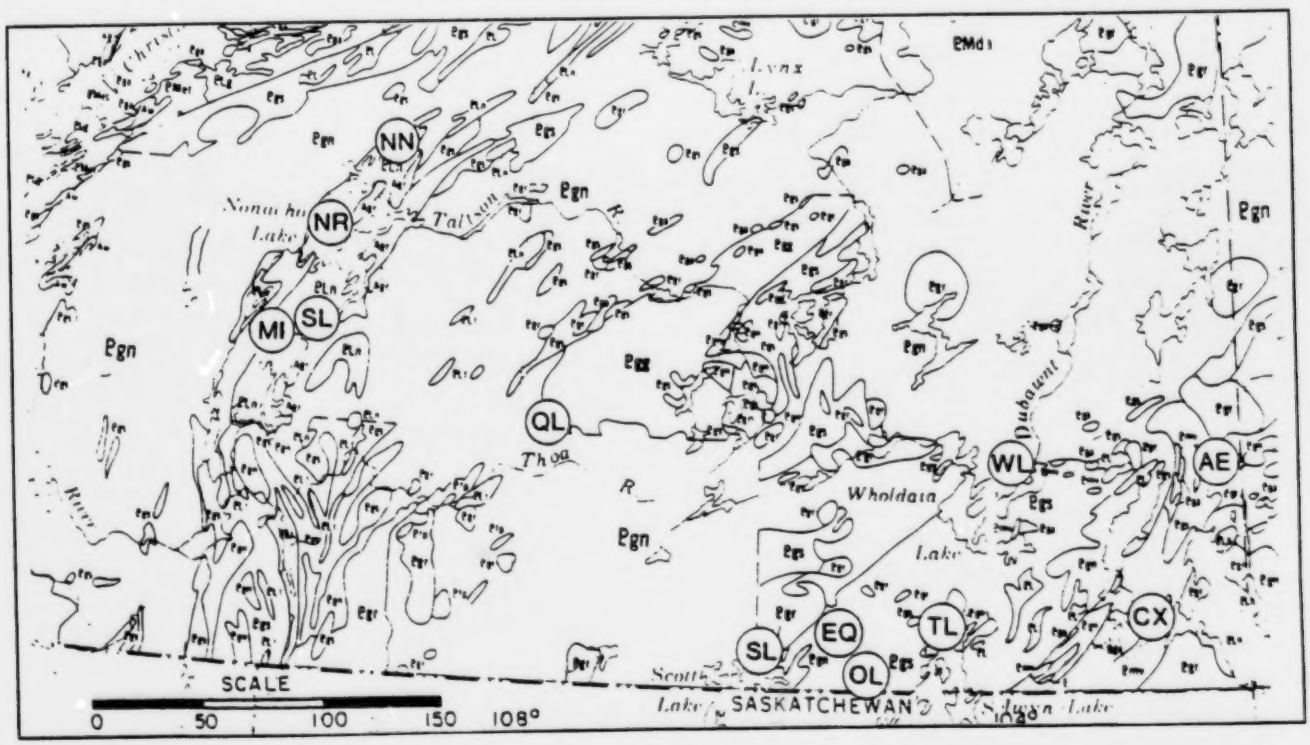


FIGURE 4: MINERAL EXPLORATION IN THE SOUTHEAST MACKENZIE REGION, 1988. Geology from GSC map 30-1963

SOUTHERN SLAVE PROVINCE

Arnold Enge

Properties explored in 1988 are shown in Figure 5.

YELLOWKNIFE VOLCANIC BELT

The main exploration target is gold-bearing quartz-carbonate shear zones cutting volcanic rocks.

Canamax Resources Inc. drilled on the NOSE claims in the Clan Lake Volcanic Complex at the east side of Sito Lake (30).

Golden Marlin Resources completed an IP survey on the MARLIN claims at Yellowknife Bay (41).

Nathan Minerals Inc. drilled on the PRO and ANNE claims north of Yellowknife. More drilling is planned before year's end (40).

Noranda Exploration Company Limited drilled on the BELL 3 claim near Sito Lake north of Yellowknife (30).

Pacific Trans Ocean Resources Ltd. completed two drill programs on the PTX claims northwest of Gordon Lake (33).

Pamorex Minerals Inc. drilled the PRN 2 and VARGA 2, 7 claims north of Yellowknife (40).

YELLOWKNIFE SUPRACRUSTAL BASIN

All exploration is for gold. The principal target is turbidite-hosted gold-bearing quartz veins.

Ardic Exploration and Development Ltd. drilled on the Thompson-Lundmark property (39), a former producing gold mine. Ardic also reconnoitred Burwash Formation metasediments.

Canamax Resources Inc. drilled on the TORO 1, 2 claims near Hook Lake (30).

Hidden Lake Gold Mines Ltd. cut lines, mapped, trenched and sampled the RUTH, RUTH NORTH and CHRISTINA 1 claims south of Gordon Lake (38).

Treasure Island Resources Corp. drilled on the JOON 2 claim east of Yellowknife (38).

Chevron Minerals Ltd. drilled the NIC claims (31) and optioned them to **Athabaska Gold Resources Ltd.** who did an IP survey and resumed drilling. Gold is associated with a leucodiorite plug.

COURAGEOUS-MACKAY LAKES VOLCANIC BELT

The main exploration target is gold at volcanic-sedimentary contacts. Gold is hosted in quartz veins and in sheared felsic volcanic rocks.

Noranda Exploration Company Ltd./TOTAL Energold Corporation joint venture are sinking a 480 m shaft on the Tundra property (26). Lateral drifting and fan drilling to delimit and define the continuity of the deposit. To date, approximately 29.5 Mt of 6.96 g/t Au have been outlined at a cutoff grade of 4 g/t Au.

Bow Valley Industries Ltd. drilled on the KR and TONY claims east of Courageous Lake (26).

Gunnar Gold-Mill City Gold completed drilling on the MOG 1-4 claims at Courageous Lake (26).

Pamorex Minerals Ltd. drilled on the Salmita property (26).

BEAULIEU RIVER VOLCANIC BELT

Volcanogenic polymetallic massive sulphide deposits were the main target of exploration.

Aber Resources Ltd./Hemisphere Development Corp. joint venture reported that drilling on the Sunrise silver-base metal deposit (37) had defined 1.87 Mt of 404.4 g/t Ag, 0.97 g/t Au, 4.2% Pb, 8.9% Zn and 0.1% Cu in one of three lenses. Drilling continues to test the extent of other massive sulphide lenses.

Noranda Exploration Company Ltd. drilled on the NORTH claim near Sunset Lake (37).

Silver Hart Mines Ltd. drilled on the BEAR 1, 2 claims west of Sunrise Lake (37).

RUSSELL-SLEMON LAKES AREA

The principal target is gold in oxide- or silicate-facies iron formation.

Aber Resources Ltd. drilled on the CON claim at the northeast end of Russell Lake (28).

Asamera Minerals Inc. drilled on the JANELLE 1 claims and the north end of Russell Lake (28).

Noranda Exploration Company Ltd. drilled on the LEMON and RUSS 1 claims (28) at the north of Slemon Lake and west of Russell Lake, respectively.

Prolific Resources Ltd. conducted a magnetic and IP survey, followed by 925 m of drilling, on the TOM, MOM and BAN claims at the southwest end of Russell Lake (28).

INDIN LAKE AREA

Neptune Resources Ltd. are proceeding with the development of the Colomac deposit, a high tonnage, low-grade gold deposit (24). Despite a successful vat-leach test in 1987, Neptune has decided to use conventional milling and gold recovery techniques; a 10,000 t/day mill is under construction. Proven and probable reserves in Zone 2 are 14.5 Mt grading 2.19 g/t Au. Neptune also drilled Zones 1 and 3.

Near the Leta Arm of Indin Lake (24), **Golden Rule Resources Ltd.** completed drilling on the ARSENO 2 and NORTH 2, 7 claims, optioned from Lintex Minerals.

Stratabound Minerals Corporation drilled three holes (50 m) on NAM 3 claim in the Indin Lake area (24).

Treasure Island Resources Ltd. drilled on the PEGLEG 1 claim west of Spider Lake (24).

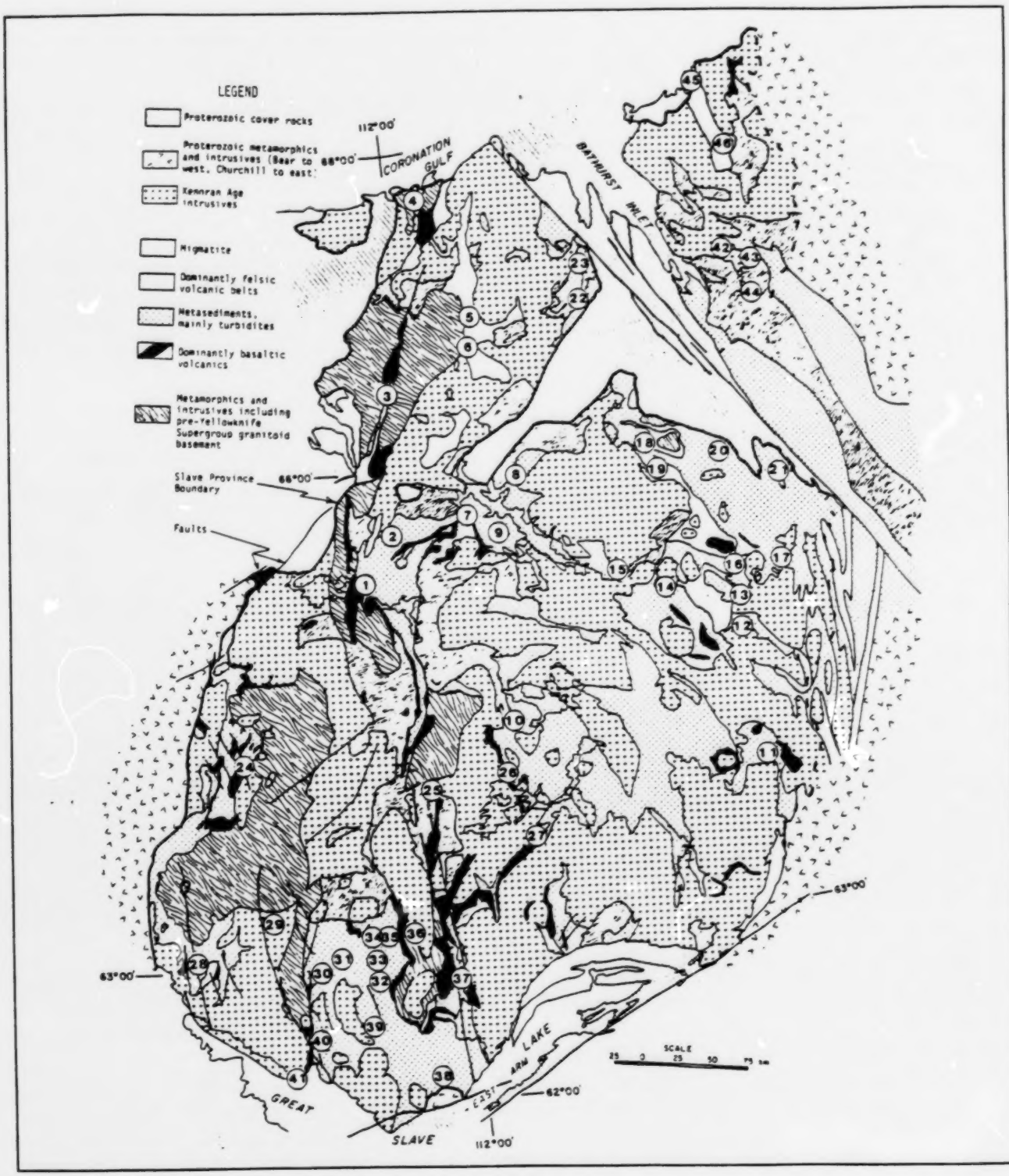


FIGURE 5: MINERAL EXPLORATION IN THE SLAVE PROVINCE, 1988.

OTHER AREAS OF SOUTH SLAVE

BHP-UTAH MINES Ltd. did geophysical surveys, trenched and sampled on the LONGSPUR claims near Fenton Lake. BHP-Utah also prospected and reconnoitred other areas in the south Slave Province.

Continental Pacific Resources Limited prospected, sampled and drilled on the ZEUS 2, GLEN 1, and LARK 1 claims at Payne Lake (37).

Durga Resources conducted an airborne geophysical survey at Allen Lake (32).

Lawrence Mining Corp. drilled on the JIM 1, 2 claims at Brown Lake (34).

Procan Exploration Company Ltd. explored in the Cameron River area (35) and on the DANE claims at Dane's Lake (27).

Viscount Resources Ltd. completed a geophysical survey and drilling on the Jay 2 claim at Spencer Lake.

Hidden Lake Gold Mines Ltd. conducted reconnaissance sampling on the GERM claim near Wheeler Lake (29).

Gunner Gold-Mill City Gold conducted an airborne geophysical survey at Winter Lake (25).

NORTHERN SLAVE PROVINCE

James B. Seaton

Properties explored in 1988 are shown on Figure 5.

In almost all cases, gold was the main target of exploration in the Slave Structural Province.

Argus Resources Ltd. drilled near "Sheit Lake" on the MUSKOX claims (15) north of Thistle Lake, to test a conductive iron formation. Encouraging gold assays were obtained from the iron formation in three small pits. Other work on the claims comprised geological mapping, geophysics and prospecting. Geophysical surveys were flown in the "Esker Lake - Sheit Lake" area and over property near Regan Lake (16).

Trigg, Woollett, Olson Consulting managed **Back River Joint Venture**'s exploration for gold-bearing iron formation on the BRAU claims. These claims, which replaced prospecting permits, cover mainly turbidite sediments east of the Hackett River Volcanic Belt.

Several localities in the George Lake area (20) were drilled, prospected and tested by **Back River Joint Venture** with "fill-in" geophysical surveys. In the Ellice River area (21) and nearby Boot Lake area grid layout, magnetometer, VLF-EM and horizontal loop EM surveys were completed.

In the Malley Rapids area (16) **Back River Joint Venture** explored MR 1 and other claims by airborne geophysical surveys.

BHP-Utah flew a geophysical (Aerodat) survey to test the TAK claims (3) near Takijuq Lake for potentially auriferous sulphide-bearing volcanics. Geological mapping and sampling was also done. On the CROWN claims (5) north of the Hood River **BHP-Utah** explored a zone of sulphide-rich volcanics by geological mapping, sampling and geophysics.

Bow Valley Industries Ltd. constructed grids and conducted ground geophysics as follow-up to an airborne geophysical survey on the BINGO 1, 2, NOR and TAN claims (7).

Bow Valley drilled auriferous iron formation on the OP claims (7) optioned from O.P. RESOURCES LTD.

Chevron Minerals Ltd. drilled auriferous iron formation on the FARN, KNUT property (23), trenched an auriferous zone on the TURNER, TURN claim group (23) and explored their extensive Hood Property (22) by soil and lithogeochemistry. Gold on the Hood Property is mainly hosted by iron formation and to a much lesser extent by tuff. These properties were optioned by Chevron from Silver Hart Mines Ltd.

Cody Hawk Resources Ltd. tested auriferous iron formation on the ROE and GAS 300 property (13) by geological mapping, VLF-EM and magnetometer surveys. The GAS 300 claim was optioned from **Cominco Ltd.**

Cogema Ltd. reconnoitred the sedimentary basin east of the Courageous Lake-Mackay Lake Volcanic belt (10). Cogema also did geophysical surveying and sampling on the SEB 1 claim (7) on the eastern shore of Contwoyto Lake.

Cominco Ltd. conducted airborne geophysics, prospecting and geological mapping on the COCO 1-9 claims (8) east of Contwoyto Lake, to delineate potentially auriferous iron formation. **Cominco** followed up an airborne geophysical survey of the REN claims (1) near the Itchen River by ground geophysical mapping and drilling. Here also iron formation was the target. At Camp Lake on the Bathurst Norsemines Property (18), core was re-examined to assess its precious metal content.

Cominco-Cogema Joint Venture performed horizontal loop EM and magnetometer surveys and diamond drilling to test iron formations on the AV, CTL, DIGGER, JON, PTC claims, west of Contwoyto Lake (9). On the east side of the lake the GOLD claims (7) were explored by geophysical surveys.

Continental Pacific Resources conducted linecutting, sampling and geochemical surveying on their Anialik River property (4).

West of Contwoyto Lake (9) **Contwoyto Goldfields Ltd.** mapped, sampled and performed magnetometer, VLF-EM and horizontal loop EM surveys on the IF 1, 3 and BUCKET claim block in search of auriferous iron formation.

Echo Bay Mines Ltd. drilled on the Lupin Mine lease (7) and on the DER 1 and PEN 1 claims to the south of the lease and west and southwest of Fingers Lake. Echo Bay Mines drilled iron formation on the CAR 9 claims near Concession Lake (7), on the CUB 1 claim near Itchen Lake (2) and on the F 1 claim near Leanne Lake (2). They also reconnoitred and prospected in the Lac de Gras (10) and Back River areas (12, 17).

Expeditor Resources Ltd. conducted magnetometer surveys, geological mapping, rock, soil and stream sediment sampling on TEC 13-16 (6), HY 1-3, 17-19 and TEC 10-12 (5) near the Hood River.

Expeditor Resources explored TEC 7-9 (17) at Casey Lake by magnetometer survey, soil and rock sampling and geological mapping. Near the Yava massive sulphide deposit north of Aitch Lake, on Prospecting Permit 1144, a silicified zone in volcanics was explored by rock geochemistry and a small grid was surveyed by VLF-EM. Targets were gold and base metals. Conductors on TEC I-6 (19) in the Hackett River Volcanic Belt outlined by an airborne survey were tested by magnetometer and VLF-EM surveys. Expeditor Resources also explored the volcanic-sedimentary contact on the western side of the Back River Volcanic Complex, where they hold HY 10-16 and HY 20-24 claims (14). Three grids were explored by magnetometer and VLF-EM surveys and prospecting.

Hecla Mining Company of Canada Ltd. prospected, did geophysical surveys and trenched on the JOHN, SHIN, DLER, CAMP, ADD block (7) east of Contwoyto Lake, after which targets were drilled on four grids. Gold showings were discovered by prospecting on two grids.

Noranda Exploration Company Ltd. constructed grids, mapped, sampled and reconnoitred south and east of Thistle Lake (15). Noranda optioned ground from Bow Valley Industries.

Orofino Resources Ltd., in joint venture with **Canuc Resources** and **Dore-Norbaska Resources,** did geological mapping, soil sampling and lithogeochemical surveys, and drilling at the Arcadia property on Coronation Gulf (4).

Pamorex Minerals Inc. drilled on the ALGOOD claims (16), the JOYCE, TANIA, PATRICIA property (12) and the TREE, TESS property (1). Two short holes were drilled on the P claims (1) in the Itchen Lake, Point Lake area that Pamorex optioned from Echo Bay Mines Ltd.

Pamorex Back River Project (12) included regional prospecting on the REX, MOR and PAM claims. Two small grids on the PAM claims were surveyed by magnetometer and VLF-EM.

Windflower Mines Ltd. drilled an EM conductor on the NAT claim at Clinton-Colden Lake (11). The target was probably massive sulphides (silver-base metals).

NORTHEASTERN SLAVE PROVINCE
BATHURST BLOCK

Walter A. Gibbins

Properties explored in 1988 are shown in Figure 5.

HIUKITAK RIVER

In May and June, **Chevron Minerals Ltd. - Galveston Resources Ltd.** joint venture drilled gold showings in amphibolitic iron formation on the LB claims in the Tinney Hills-Hiukitak River area (42).

Enexco International Ltd. mapped, trenched and sampled on the ENEX claims (adjacent to the LB claims).

BHP-Utah Mines Ltd. explored a prospecting permit (43) and staked several new claims.

HI Tech Resources, Expeditor Resources Ltd. and **Mingold Resources Ltd.** explored prospecting permits east of the Western River, NTS 76J/1 (44).

HOPE BAY VOLCANIC BELT

Abermin Corporation did geophysical surveys and trenched and mapped gold prospects near Ida Point, Hope Bay and Roberts Lake (45). The company also reconnoitred and staked claims in the upper Koignuk River area (46).

DISTRICT OF KEEWATIN

J.L. Griep

A significant increase in exploration is evident from the 35 prospecting permits issued in 1988 (5 issued in 1987 and 26 in 1986). Gold continues to be the principal target and exploration focused on the Archean Kaminak greenstone belt. The possible association of precious metals with uranium has also sparked interest in Proterozoic felsic volcanic rocks of the Baker Lake and Yathkyed Lake basins. Properties described below are shown in Figure 6.

GOLD

On behalf of **Agnico Eagle Mines Ltd., W.A. Hubacheck Consultants Ltd.** reconnoitred sulphide showings in the Ennadai greenstone belt (1) and gossans and rusty zones associated with anorthosite complexes east of Baker Lake (23) and near Daly Bay (24).

Claude Resources Inc. explored permits and claims near Sandy Beach Lake (2) with magnetic surveys, soil geochemistry as well as prospecting and geological mapping.

Noranda Exploration Ltd. optioned claims in the Lothrop Lake area (3) from Suncor Inc. and conducted mapping, lithogeochemical and IP surveys.

The Turquetil Lake project (5) operated by **Dejour Mines Ltd.** in joint venture with **Noble Peak Resources Ltd.** found gold over significant lengths and widths at the Joyce showing (10,350 m of diamond drilling). Exploration consisted of mapping, geochemistry, and geophysics to test results of a 1988 Dighem survey.

Sunmist Energy '86 Inc. continued operations at Maguse Lake (6). Exploration of targets defined by a 1987 airborne survey consisted of 3,050 m of diamond drilling, till geochemistry, VLF, HLEM and magnetometer surveys.

BHP-Utah Mines Ltd. acquired two prospecting permits south of Kaminak Lake (7) and staked claims adjoining the Turquetil and Maguse Lake properties. Reconnaissance included mapping, prospecting, sampling and regional till geochemistry.

Sikaman Gold Resources Ltd. explored claims at Kaminak Lake (9) and at Maze Lake (17) with a Dighem survey and drilled just over 1000 m in 17 holes.

Two persons with **Asamera Minerals Inc.** prospected and mapped permits north of Carr Lake (11) and at O'Neill Lake (12). This field party also mapped and sampled targets at the Meadowbank (25) joint-venture project (Comaplex Minerals Corp).

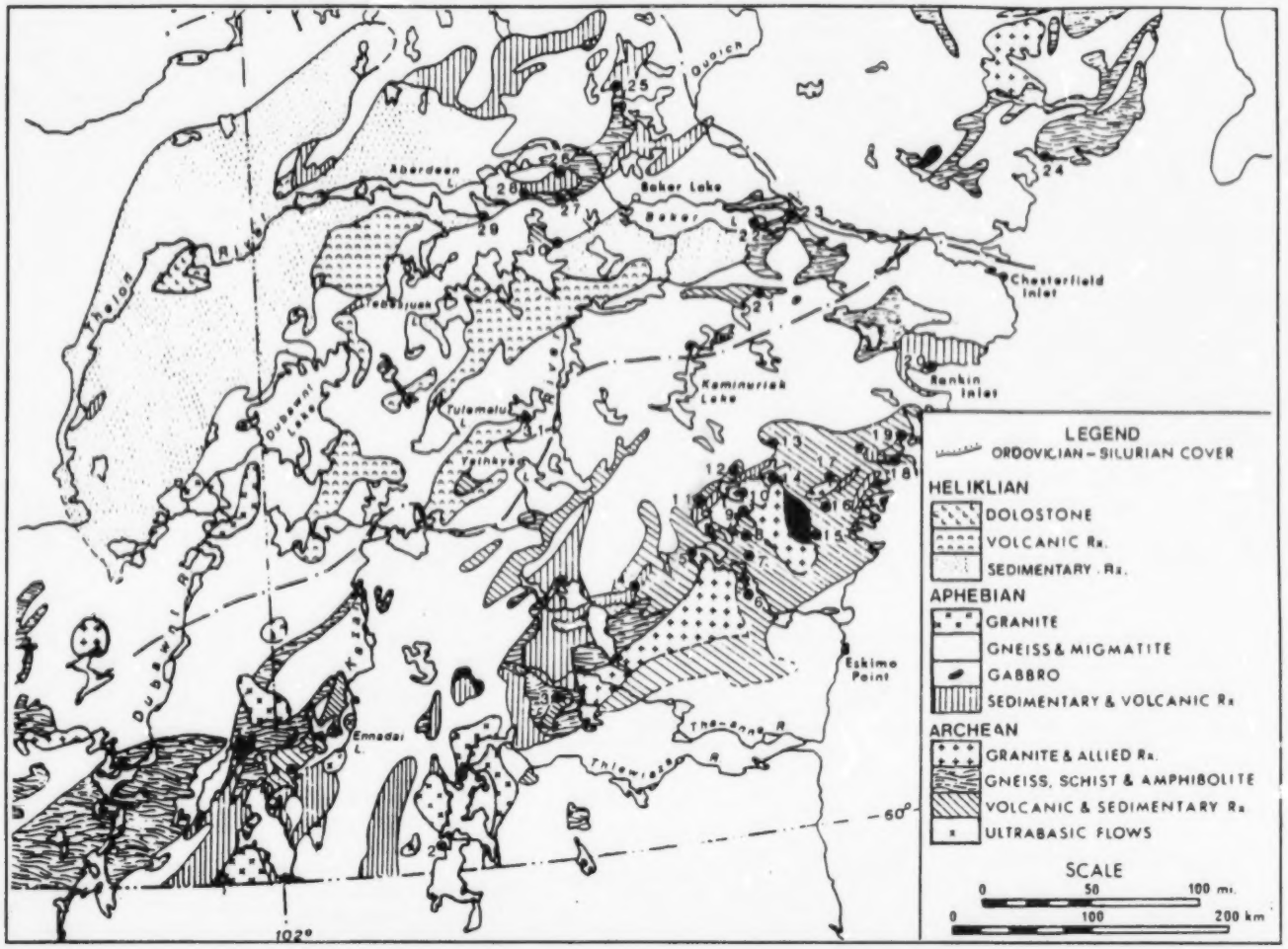


FIGURE 6: MINERAL EXPLORATION IN THE KEEWATIN DISTRICT, 1988
Geology after Wright, 1967.

Noble Peak Resources Ltd. explored at Happy Lake (13) and on newly acquired claims (Southwin project) near Quartzite Lake (14). In the latter area, diamond drilling (6,900 m), mapping, prospecting, geochemistry and geophysical surveys (VLF, Mag, IP) tested targets, defined by a 1988 Dighem survey. At Happy Lake ground surveys were complemented by overburden drilling and 3,250 m of diamond drilling.

Placer-Dome Inc. mapped, sampled and prospected iron formations on four permits south (8) and southeast (15) of Kaminak Lake.

On its Fat Lake property (16) **Borealis Exploration Ltd.** drove a 330 m long decline to a vertical depth of 50 m. A number of mineralized veins were intersected in the diorite host rock. Exploration included 1,270 m of drilling, channel sampling, mapping and ground magnetometer and VLF surveying. Sampling, mapping and geophysics also explored permits at Kaminak Lake (10) and in the Copperneedle River area (16) south of Fat Lake. The company also operated the Pistol Bay Project (19) for **Faraway Gold Mines Ltd.** and conducted geophysical surveying, sampling and mapping. In the Padlei area (4), **Borealis** acquired permits issued to Ardic Exploration Ltd. and Stratabound Mineral Corp. Sedimentological studies, prospecting and channel sampling explored palaeoplacers of the early Proterozoic Montgomery Lake Group for precious metals.

Diamond drilling (2,950 m), mapping, sampling and magnetometer surveying were done by **Canadian Nickel Co. Ltd.** on its IGLOO claims at Wilson Bay (18).

Comaplex Minerals Corp. conducted regional mapping and lithogeochemical surveys on 14 prospecting permits in the McQuoid greenstone belt (21) near Baker Lake.

Pamorex Minerals Inc. drilled 1,045 m, sampled and did VLF and magnetometer surveys on the SAM claims west of Baker Lake (27).

URANIUM AND OTHER COMMODITIES

Three companies explored for unconformity related uranium deposits west of Baker Lake.

In the spring of 1988, **Urangesellschaft Canada Ltd.** commissioned a feasibility study of the Kiggavik (Lone Gull) deposit (28). Environmental baseline studies and geotechnical drilling (4,070 m) evaluated potential mill site, tailings disposal, airstrip and docksite facilities.

Exploration on the Sissons-Schultz south property (28) operated by **Urangesellschaft**, in joint venture with **PNC Exploration (Canada) Co. Ltd.** comprised diamond drilling (3,250 m) and detailed resistivity, gravity and soil geochemical surveys, mapping and radiometric prospecting.

PNC Exploration (Canada) Co. Ltd. drilled 1,100 m on a number of targets at its Schultz Lake project (26). Work included EM, VLF and gravity surveys, detailed geochemical studies, mapping and radiometric prospecting.

CEGB Exploration (Canada) Ltd. reconnoitred the Thelon Basin south of Aberdeen and Schultz Lakes (29). The company also obtained 20% interest in the Kiggavik Project.

Taiga Consultants Ltd. surveyed Proterozoic felsic volcanic rocks of the Baker Lake (30) and Yathkyed Lake Basins (31) on permits held by **Norgold Ltd.** A number of uranium showings were mapped and sampled to determine gold and PGE potential.

Comaplex Minerals Corp., which holds a number of claims and three prospecting permits in the Christopher Island area (22) east of Baker Lake, also tested uranium showings for precious metals.

Asamera Minerals Inc. drilled 2,400 m on its Rankin Inlet joint venture with **Comaplex.** Cu-Ni minerals at the Rankin mine (20) were tested for PGE content. Mapping, sampling, magnetic and MaxMin surveys were done by **Comaplex** on an extension of the mineralized zone.

PART 2: GEOLOGICAL INVESTIGATIONS AND ABSTRACTS OF PAPERS 16TH ANNUAL GEOSCIENCE FORUM YELLOWKNIFE, NWT; DECEMBER 6 TO 8, 1988

TONALITE-HOSTED AU-QUARTZ VEIN/ SHEAR ZONE MINERALIZATION, ARCADIA BAY, CORONATION GULF, NWT

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Tonalite-hosted Au-quartz vein/ shear zone deposits in the Arcadia Bay area (610 km north of Yellowknife) on the south shore of Coronation Gulf (780,000 t grading 7.5 g/t Au, Northern Miner, October 31, 1988), are hosted predominantly by strongly to intensely foliated tonalite and marginal mafic rocks of the Anialik River Granite Gneiss, which intrude the supracrustals of the Anialik River Greenstone Belt (both approximately 2.7 Ga).

Geological mapping at 1:15 000 scale of 55 km^2 around the gold veins was completed during the summer of 1988. Additional mapping of the shear zone-hosted mineralization, exposed in trenches, at 1:20, 1:120 and 1:500 scales, initiated in 1987, was also completed.

The main objectives of this study are to:

1) clarify the exact nature of the western Anialik tonalite/ supracrustal contact and hence define the relative timing relationships between the supracrustals of the Anialik River Greenstone Belt and the tonalitic intrusive complex;

2) determine the intrusive and timing relationships of the "felsic" dikes in the Anialik tonalite, their equivalents marginal to the tonalite, the felsic porphyritic dikes intruding the supracrustals, and the Salt Lake, Arcadia Bay, and Chin Lake Stocks;

3) establish the controls and origin of gold mineralization in the Arcadia Bay area;

4) constrain the relative ages of intrusion, deformation and mineralization using U/Pb zircon and other geochronological techniques;

5) provide parameters for gold exploration within granitoid rocks in the NWT.

The principal results to date are outlined below:

1) almost half of the area mapped is underlain by a coarse grained leucocratic hornblende-biotite tonalite with subordinate trondhjemitic phases, which are heterogeneously deformed, ranging from massive to intensely foliated and locally mylonitic. Westward intensification in fabric sub-parallel to the margin of the tonalite, and a consequent increase in concentration of discrete zones of mylonitization, which host mineralization, both sub-parallel and oblique to the tonalite margin is identified. The mineralized area is bounded by two major, parallel, shear zones, the western Arcadia Creek and eastern Gray's Bay Shear Zones, which have strike lengths of approximately 15 km, and are 4.5 km apart. Early foliation trends in the tonalite locally exhibit a sigmoidal pattern across Gray's Bay Shear Zone consistent with a component of horizontal dextral shear. Two more regional shears to the east of the Gray's Bay Shear Zone, namely the Splitenz Lake and Anialik River Shear Zones are sub-parallel to them. Dextral shear is also evident along these structures (Padgham, Fyson, and Jackson, Pers comm);

2) the tonalite is subdivided into six distinct mappable units: a small lens shaped area (350 x 900 m) of undeformed hornblende-biotite leucotonalite; local areas of intrusion breccia comprising mesotonalite blocks up to 1 m in size in leucotonalite; zones of leucotonalite with thin mesotonalite schlieren; mesotonalite; "mixed" zones, predominantly mesotonalite with leucotonalite injections and dikes; and a mafic marginal phase is also sub-divided and appears to be a tectonically modified gradation from mesotonalite through diorite into gabbro;

3) the Anialik tonalite is intruded by numerous dikes of mafic, intermediate and felsic composition. The least abundant are north and west trending, fine to medium grained, mafic dikes of gabbroic composition, which are intensely foliated and altered.

Grey weathering, predominantly fine grained, locally porphyritic, dikes of intermediate composition are more widespread. These are strongly to intensely foliated, range in width from under 10 cm up to 2 m and commonly occur in zones (up to 50 m wide and up to 800 m long) of clustered, disrupted blocks which may be a product of folding and boudinage. These intermediate dikes are themselves intruded by later, pink weathering "felsic" dikes which disaggregate already disrupted blocks and also cross-cut and intrude along their margins.

The most common and economically important intrusions are the "felsic" dikes. "Felsic" dikes (granodiorite/tonalite, granite, microgranite, aplite, pegmatite and quartz-feldspar porphyries) are predominantly intensely deformed and exhibit good cross-cutting relationships. The earliest dikes (usually less than 30 cm wide) are north-northeast trending, greyish to pink weathering, medium to coarse grained, strongly foliated and folded granodiorite/tonalite. Later granite, microgranite, pegmatite and aplite dikes cross-cut the early phase dikes and also one another. Those with an approximate 030° trend are commonly parallel or sub-parallel to the mineralized shears and incorporated into them. Distinguishing between the various mylonitized dikes, and tonalite is difficult especially where hematite alteration and silicification-obscures relationships. However, dikes typically exhibit sharp rather than diffuse margins. Late syntectonic, cross-cutting, mineralized dikes (usually less than 0.5 m wide) within the shears are common and may contain as much as 3% pyrite as disseminate euhedral crystals, 1-2 mm in size. Dikes distant from the shears and mineralized are invariably barren and carry only trace pyrite. The 030° trending dikes are commonly cut by a set of 045° trending granite and pegmatite dikes that are less intensely foliated and appear to be sparsely mineralized. All the aforementioned dikes are cut by late syntectonic, typically northwest trending, garnet-bearing aplites and pegmatites (ranging in size from less than 5 cm up to 2 m wide) which exhibit alignment of crystal growth parallel to the foliation in the tonalite and poorly developed boudinage.

Rare, late synkinematic quartz-feldspar porphyry dikes in the mafic marginal zone cross-cut earlier dikes and fabrics but are themselves deformed by the north-northeasterly shears. These dikes become more prevalent in the "Sheeted Zone" and supracrustal belt;

4) supracrustals in the Arcadia Bay area are predominantly felsic volcanic, but approximately 50% of the volcanic belt mapped comprises a large, possibly syn-volcanic, quartz-feldspar porphyry intrusion. Volcanics also include: felsic tuffaceous and fragmental units; subordinate intermediate flows and/or sills, fragmentals and tuffaceous units; minor mafic volcanic rocks, comprising amygdaloidal, phyric and variolitic flows, and tuffs; and minor intravolcanic sediments sparsely distributed throughout the belt;

5) the supracrustals are intruded by two large gabbro intrusions (Golfing Lake Gabbro) and related northerly trending gabbro and diorite dikes. The gabbro intrusions cross-cut the large quartz-feldspar porphyry and are themselves cut by a second phase of quartz-feldspar porphyritic dikes similar to the larger intrusion;

6) the Golfing Lake gabbro and the volcanics are intruded by pink weathering, quartz-rich, coarse grained, strongly lineated, locally porphyritic quartz monzonites, the Salt Lake and Arcadia Bay Stocks. Their intrusive relationships, continuity of shear zones in the volcanics across their margins, coupled with the strong linear fabric development supports a pre- or syn- tectonic emplacement;

7) dark greenish to black weathering, fine grained, intensely foliated mafic dikes cross-cut the supracrustals and the Salt Lake and Arcadia Bay Stocks;

8) all rocks in the supracrustal belt are intruded by a suite of predominantly northerly trending, pink, fine grained, up to 2 m wide, quartz and quartz-feldspar porphyritic felsic dikes which are also found in the "Sheeted Zone" and mafic marginal rocks of the tonalite;

9) the contact between the Anialik tonalite and the supracrustals is defined by a 200-800 m wide high strain zone, here named the "Sheeted Zone". The "Sheeted Zone" comprises schistose to mylonitized (typically dark green weathering, chloritized and epidotized) equivalents of the mafic marginal phase of the tonalite and appears gradational into highly strained felsic volcanics to the west. These intensely deformed mafic intrusions are themselves intruded by numerous pink "felsic" dikes ranging in width from <5 cm up to 2 m. These dikes are parallel and subparallel to the foliation of the high strain zone and locally make up approximately 80% of its width.

Both dikes and deformed mafic intrusions are tight to isoclinally folded about steeply dipping, north-northeast striking axial surfaces. These folds (ranging in wavelength from a few to 7 m, with amplitudes of up to 30 m) have moderate to subvertical plunges predominantly to the south and southwest; north-northeast plunges have also been observed. Linear fabric development is absent in this high strain zone and it is interpreted as a zone of intense flattening possibly produced during emplacement of the Anialik River Granite Gneiss into the supracrustals. The supracrustals to the west of the "Sheeted Zone" represent a domain of pervasive linear fabric characterized by streaked and rodded quartz and feldspar phenocrysts, in the large, probably synvolcanic quartz-feldspar porphyry intrusion, and the preferred orientation of deformed volcanic fragments observed in fragmental units marginal to the porphyry. A possible model that combines regional shear movement and high strain flattening is that flattening (pure shear) took place prior to and was locally overprinted by translation (simple shear);

10) the northern margin of a discordant, post-tectonic, apparently unmineralized, quartz monzonite, the Chin Lake Stock, intrudes the supracrustal belt, tonalite intrusion complex and related dikes, and cross-cuts major shears that extend into the southern part of the mapped area. The contact of this predominantly coarse grained, massive and pink to red weathering quartz monzonite is sharp. It contains minor xenoliths and no associated dikes are traceable from it;

11) mineralization is predominantly hosted by longitudinally extensive (up to 5 km) ductile/brittle shear zones containing mylonitized, tonalite, associated mafic phases, and "felsic" dikes and quartz veins in the western Anialik intrusive complex. Ore mineralogy comprises predominantly pyrite with subordinate chalcopyrite, molybdenite, galena and sphalerite within quartz, quartz-carbonate veins and mylonitized tonalite, diorite, gabbro and "felsic" dikes. Visible gold (rare 1 mm size specks) occurs in granular aggregates of deformed pyrite in the early quartz;

12) Three stages in the development of the quartz veins are recognized:

(a) an early synkinematic, intensely sheared streaky grey quartz cross-cuts early felsic dikes and fabrics. It commonly contains highly deformed pyrite, either as massive granular aggregates of crushed relict subhedra, or as tails of broken the shear zone walls. Molybdenite occurs as a pale metallic blue-grey "paint" on sheared quartz. Galena is similarly highly deformed in the early quartz and has a dull grey appearance,

(b) main stage, less deformed, white, grey or buff coloured quartz typically contains large euhedral pyrite, and small sparsely disseminated aggregates of galena, molybdenite, chalcopyrite, sphalerite and buff colour carbonate. It also contains silicified and hematite altered fragments of wall rock (typically mylonitised tonalite and "felsic" dikes),

(c) late post deformational infilling of fractures in the quartz-vein mineralization/shear stems is represented by vugs rimmed by clear, white and pink euhedral quartz and infilled with white or brown weathering carbonate. These quartz filled vugs are often red stained due to late hematite alteration; and

13) Mineralization in the supracrustal belt and related intrusions is sparse, but a number of areas with economical potential are evident:

(a) pyritic gossaned zones in the very fine grained felsic tuffaceous rocks and some of the chloritic schistose units,

(b) mineralized (predominantly pyrite) shears and aplitic dikes in the Salt Lake and Arcadia Bay Stocks,

(c) minor shears with sulphides occurring in the Golfing Lake Gabbro.

Conclusions

Conclusions drawn from field mapping during 1987 and 1988 include:

1) the felsic dikes of the "Sheeted Zone" were intruded synkinematically into the high strain zone since they

contain xenoliths of more strained material, but are themselves also highly deformed. Hence, tonalitic magma was intruded during deformation and may have caused the flattening;

2) the "Sheeted Zone" in the area of the Sidewalk Vein shows:

i) strain intensification,

ii) a higher frequency of costructural, synkinematic "felsic" dikes,

iii) later, synkinematic, costructural Au-quartz veins;

3) late, but synkinematic; costructural Au-quartz veins and "felsic dikes" in the Sidewalk Vein area together with:

i) many co-structural, shear zone-hosted felsic dikes and Au-quartz veins elsewhere in other narrower shear zones (e.g. the North Central and H-veins) and,

ii) shear zone-hosted gold mineralization as much as 5 km into the tonalite ("C-Veins") suggests that the Au-quartz veins in the Arcadia Bay area are magmatically associated with the tonalitic (Archean TTG-type) intrusive rocks.

Acknowledgements

This work is a contribution to the Canada-Northwest Territories Mineral Development Agreement 1987-1991. We wish to thank Orofino Resources Limited for their logistical support and ongoing interest in the research.

ISOTOPIC AND TRACE ELEMENT CHARACTERISTICS OF SCHEELITE FROM ARCHEAN GOLD DEPOSITS

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The Sm-Nd, Rb-Sr and Pb isotopic composition, and rare earth element patterns of scheelite from Archean gold deposits are studied: 1) to develop a reliable method of dating gold deposits; and, 2) to constrain the possible source of these fluids.

An initial attempt at obtaining an isochron using the Sm-Nd system on scheelite samples from the Hollinger-McIntyre vein system at Timmins, Ontario has been successful, although the age obtained (2380 $\pm$ 40 Ma) is not in agreement with earlier $^{40}Ar/^{39}Ar$ work (Masliwec et al., 1981). Sr initial ratios on these samples indicate a crustal source for the Sr while the Nd initial ratios yield more of a mantle signature. This suggests that gold deposits may be the result of an interaction of mantle- and crustal-derived fluids.

Neutron activation analyses on scheelites from a variety of gold mines, in Superior Province (Hollinger-McIntyre, Dome, Sigma, Hard Rock, Leitch), and in Slave Province (Lupin, Salmita, Con), as well as several skarn deposits in the Cordillera and Shield, yield REE patterns that are distinct from one deposit to the next, and very homogeneous within a single deposit. This indicates that scheelite is a reliable indicator of the REE contents of the fluid, and that, at the scale of individual mines, the fluids responsible for gold deposition were quite homogeneous.

SEDIMENTOLOGY, STRUCTURE AND ECONOMIC GEOLOGY OF THE POORFISH-WINDY THRUST-FOLD BELT, ENNADAI LAKE AREA (65/C) DISTRICT OF KEEWATIN, AND THE SHELF TO FOREDEEP TRANSITION IN THE FORELAND OF TRANS-HUDSON OROGEN

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The principal structural elements in the Poorfish-Windy belt are: northwest-propagating piggyback thrusts (including a northwest-vergent duplex cut by in sequence, breaching thrusts); northwest-vergent macro-folds; and late north-northwest and north-northeast trending, brittle normal faults. The thrusts are responsible for a minimum horizontal shortening of 75 km. The sedimentary record of the Hurwitz Group and Kiyuk Group (new name, replaces Ennadai Group) is compatible with a simple model in which the Kinga shelf was drowned by a north and northwest-migrating foredeep and in which cycles of sedimentation are related to rates of thrust front migration and thrust loading. Sedimentation of supermature quartz arenites deposited on Archean crust (Kinga Fm.) was interrupted by passage of a peripheral bulge (sub-Ameto unconformity) and abruptly followed by axial zone "deep" water arkoses and siltstones and mafic igneous rocks (Ameto Fm) that shoaled upward to shelf cryptalgal laminates and fine-grained siliciclastics on the hinterland side of the axial zone (Watterson Fm.). Renewed rapid thrusting and deepening resulted in fine-grained sedimentation of the Ducker Fm., followed by arrival of the thrust front and stripping of sub-Tavani units on the east, concurrent with uninterrupted sedimentation on the west (sub-Tavani unconformity and Tavani Fm). Arkoses and siltstones of the "Hurwitz H" (new unit) mark the onset of a third cycle immediately prior to the arrival of basement-cored thrust sheets, an erosional front, and deposition of coarse-grained alluvium (Kiyuk Gp.) that was subsequently thrust/fold deformed (in part cannibalized?) by continued northwestward advance of the thrust complex. Implicit in the model is a dynamic causal link to processes in Trans-Hudson Orogen: geochronology on Hurwitz Gp. igneous rocks will be a critical first test.

The numerous gossans mapped are inferred to be related to thrust-fold deformation, and to fluid movement along late cross-faults. Some have yielded anomalous gold and arsenic values in Hurwitz and Kiyuk Group rocks, suggesting that structural traps in these units may be favourable exploration targets.

TUNGSTEN SKARN DEPOSITS IN THE NORTHERN CORDILLERA WITH PARTICULAR REFERENCE TO MACTUNG

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In the Northern Cordillera, scheelite skarn deposits, including Mactung and Cantung, are hosted by Cambrian to Lower Ordovician black, carbonaceous, finely intercalated pelite-limestone, impure limestone and limestone slump breccias typical of continental margin environment. Regional deformation resulted in folding, weak recrystallisation and development of cleavage in these units. Locally, post orogenic emplacement of numerous, late Cretaceous, probably subduction-related

quartz-monzonite intrusives produced hornfels and calc-silicate assemblages in thermal aureoles.

At Mactung and Cantung quartz veins cross cutting pelite can be traced into skarn mineral assemblages that replaced limestone and, thus, are considered hydrothermal equivalents, their difference reflecting host rock composition rather than process. Quartz veins and skarn represent the fossil plumbing system of the hydrothermal fluids and, although veins are roughly parallel and skarns concordant with bedding, together they are analogous to stockworks within porphyry Mo-W systems.

Grade differences between ore zones reflect both the relative abundance of interbedded pelite (barren waste) and the permeability of the limestone. Within the Ore Limestone at Cantung skarn typically occurs as conformable beds separated by unaltered limestone. This morphology indicates that the Ore Limestone was impermeable and that hydrothermal fluids moved along bedding planes reacting with limestone to form skarn but could not infiltrate far into the limestone. At Mactung, in contrast, the lower ore body is hosted by a limestone slump breccia and is pervasively altered to skarn reflecting its high permeability.

At Mactung, quartz vein densities and orientations, location of pegmatites and aplites, patterns of alteration and the up-dip up-section stacking of ore in each carbonate unit all indicate that hydrothermal fluids were derived from a magma which crystallized at depths south of the deposit. Residual magmatic hydrothermal solutions gathered in the roof zone of this pluton, eventually broke out and migrated upwards by hydrofracturing that exploited structural weaknesses along bedding and cleavage planes. Thus, skarn formed far from the contact of the parent intrusive and outcropping stocks are coincidental.

THE SIGNIFICANCE OF ULTRAMAFIC, GABBROIC AND ANORTHOSITIC REMNANTS IN SOME GNEISSES AT THE EAST MARGIN OF TALTSON MAGMATIC ZONE

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The gneiss terrane on the east margin of Taltson Magmatic Zone is divisible into two subterranes: an eastern one consisting predominantly of granitic gneisses with variable proportions of mafic schlieren intruded by granite; and a southwestern one which includes in addition to the lithologies of the eastern subterrane, remnants of a high grade supracrustal gneiss assemblage, locally abundant amphibolite inclusions and a more complex suite of granitic intrusives. Major faults accompanied by mylonite separate these subterranes from one another and separate both from the main zone of Taltson magmatism to the west.

Two mafic gneiss complexes occur at the west contact of the eastern gneiss subterrane. Banded talc-serpentine, metagabbro, and anorthosite remnants have been found adjacent to the Taltson batholiths whereas only metagabbro and anorthosite have been found opposed to gneisses of the southwestern terrane. Lithologic correlation of enclosing granitic phases suggests that the mafic rocks are most likely early Aphebian or older. At least some of the amphibolite inclusions of the south-western gneiss sub-terrane are enclosed in granite dated at 2334 Ma.

The hypothesis is advanced that the two major mafic gneiss complexes are remnants of prekinematic layered mafic intrusions. These intrusions reflect initiation of an Archean or early Aphebian rift. Uplift and tension across the early rift zone resulted in emplacement of mafic dykes parallel to it. Remnants of these dykes may be preserved as amphibolite inclusions in the southwestern gneiss terrane. The current distribution of the eastern and western gneiss terranes is an artifact of strike-slip shear which followed much later emplacement of the Taltson batholiths.

LUPIN MINE - AN UPDATE

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Echo Bay Mines Ltd. began producing from the Lupin ore body in 1982 at an initial rate of about 900 t/day. Since then the mine has produced over one million oz. of gold and, through a series of mill upgrades, is now producing at about 1720 t/day. Over the years under-ground exploration and development have located sufficient ore reserves to more than offset production. In 1983 proven and probable reserves were equivalent to 5 years production at present rates, while in 1987 proven and probable reserves were sufficient for 5.6 years production at present rates.

The Lupin deposit is made up of three main ore zones known as the East, Centre, and West Zones. These zones lie within one ore-hosting amphibolitic iron formation horizon which has been tightly folded into an anticline-syncline couple. The fold noses plunge steeply toward north-northeast at about 65° and the fold limbs dip steeply at 75°-85°. Ore reserves have been outlined in both the Centre and West Zones from surface to 650 m below surface. Both the Centre and West Zones are open to depths below the 650 m level. The West Zone is open along strike south of the shaft.

A shaft-deepening program is underway at the present time to sink the shaft to access the West and Centre Zones at the 890 m level during 1989. A second phase of shaft deepening to the 1130 m level will be done subsequent to drifting in the Centre Zone on the 890 m level.

THE KAMINAK LAKE ALKALINE COMPLEX - A LATE ARCHEAN INTRUSION IN THE RANKIN-ENNADAI GREENSTONE BELT

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The Kaminak Lake alkaline complex (63°17'N, 94°43'W) intrudes an almost classic granitoid greenstone terrane, the

Rankin-Ennadai belt, of the western Churchill Province. The Archean host volcanic rocks are broadly divisible into three groups; a lower predominantly mafic greenstone unit, an intermediate unit with both mafic and felsic horizons and an upper felsic unit. The volcanic sequence is topped by a unit with greywackes. The greenstones are variably deformed showing at least two foliations and evidence of a late brittle deformation. Metamorphic overprinting has produced lower greenschist to upper amphibolite grade (near contacts with plutons) assemblages in mafic units but felsic units generally show only minor sericitization.

Intrusive gabbros and diorites, were the earliest plutonic units, followed by tonalites and then by granitoids. Many units originally mapped as gabbros are, in fact, heterogeneous mafic migmatites with igneous and supracrustal components. A small number of gabbro plutons have been observed, some lacking any field evidence of post-intrusive deformation or metamorphic overprinting. Tonalites are the most abundant plutonic rocks. They consist of feldspar with hornblende and biotite and are commonly homogeneous and massive. Granitoids are more abundant than indicated by the geological map. Distinguishable by a high quartz content, granitoids occur as small late bodies at most contacts of gabbro with tonalite. Granitoids are more variable in appearance than gabbros or tonalites and range from fine-grained aplitic dykes through equigranular granitic units to larger porphyritic plutons.

The alkaline complex is a northeast trending oval about 7 km x 1.5 km in size. It is poorly exposed with about 30% being covered by water and most of the remainder covered by glacial drift and vegetation. The central core is not exposed. Red-brown (commonly silica undersaturated) syenites, the northeastern portion of the complex, lie between the host volcanic and tonalites and the main body of the complex. Minor fenitization of the country rock adjacent to the syenites was noted. The main body of the complex comprises grey to black ijolitic rocks whose contact with the syenites is not exposed. The ijolites consist largely of nepheline, aegirine-augite, biotite and feldspar in varying proportions. Melanite garnet is common. Outer biotite-rich ijolite appears to grade transitionally to pyroxenite towards the centre of the complex. Inhomogeneous units within the biotite-rich ijolites consist of irregular masses of fine-grained mafic silicate and calcitic carbonate. Field relations within these units and between them and the coarser grained ijolitic rocks are not clear. Late carbonatite dykes or lenses, are small in volume and clearly cut volcanic, tonalitic and alkaline intrusive units. Fenitization of volcanic rocks adjacent to the ijolitic intrusive rocks is intense but fenitization of the tonalities is less severe. There is little evidence of post-intrusive deformation or metamorphic overprinting in the complex. Rare elements have been found only in trace amounts.

Preliminary Sm-Nd whole rock ages of 2545 ± 97 Ma for the alkaline intrusive silicates and carbonatites and 2672 ± 148 Ma for the volcanic rocks have been determined. The Sm-Nd age for the volcanic suite is in good agreement with zircon ages of 2697.5 ± 1.4 and 2692.0 ± 1.0 Ma recently determined for two felsic units by Mortensen and Thorpe of the Geological Survey of Canada. Precise ages for gabbroic to granitoid host rocks have not yet been determined. Initial U-Pb analyses of zircons from six syenites failed to yield an age of crystallization for the alkaline complex. The zircons are of poor quality and the data suggest that more than one post-crystallization process (eg. diffusion, episodic loss) has resulted in 20% to 40% Pb loss. The oldest discordant $^{207}Pb/^{206}Pb$ age obtained, 2610 Ma, represents a current minimum U-Pb age for the complex. This is somewhat older but still within error of the Sm-Nd whole rock age. Whole rock Rb-Sr and Pb-Pb isotopic compositions were partly to wholly reset during the Hudsonian and cannot be used to determine initial ages of emplacement.

DETAILED AIRBORNE GEOPHYSICAL SURVEYS OF THE LUPIN AND THOR AREAS, A GAMMA RAY SPECTROMETER APPLICATION TO MINERAL DEPOSIT STUDIES INCLUDING MAGNETOMETER AND VLF DATA

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Two detailed multiparameter airborne geophysical surveys were flown by the GSC Skyvan system in 1988, as part of a Canada-NWT MDA project in the vicinity of the Lupin (Au) and Thor Lake (Be-rare metal) deposits. Results of this work compliment ongoing geoscientific studies directed at understanding deposit genesis and thus assist exploration. The publication consists of eleven geophysical maps (ternary radioelement, exposure rate, K, U, Th, U/Th, U/K, Th/K, total field magnetic, VLF-EM total field and quadrature) stacked profiles and a geological map.

The geophysical surveys effectively map many aspects of the geology in the two areas. At Lupin, high U and U/Th ratio and low Th/K ratio and aeromagnetic response over the adjacent granite may indicate a high degree of magmatic differentiation. At Thor Lake (originally discovered by reconnaissance gamma ray spectrometry) the mineralized zones are characterized by high Th and U. In both areas the airborne data indicates many features which remain unexplained when compared with available geology. An example of these is the anomalous thorium zone which parallels the East Arm of Great Slave Lake.

GEOCHEMISTRY (TILL, GOSSAN AND LAKE SEDIMENT - Au AND PGE) AND SURFICIAL GEOLOGY OF THE FERGUSON, YATHKYED AND CONTWOYTO LAKES AREAS, NWT

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At Ferguson Lake, detailed sampling of gossan and till was carried out around the PGE-bearing nickel-copper sulphide mineralization. In the Yathyked Lake area, both reconnaissance and detailed till sampling surveys were completed over the gold-bearing metavolcanic belt.

In the Contwoyto Lake area, both reconnaissance lake sediment and till surveys were carried out over an 1100 km^2 area covering the Yellowknife Supergroup terrane on the southwest side of the lake. Detailed sampling of till was also carried out on six grids on which gold mineralization is known to occur. The purpose of this survey was to examine the geochemical dispersal patterns

and to evaluate the distribution of gold and associated elements in the various till fractions (eg. -80 mesh, -250 mesh, <2 µm, heavy mineral concentrates and pebble sizes, 6 to 2 mm). Field checking of an airphoto interpretation of the surficial geology was completed. The area flooded by Glacial Lake Contwoyto was estimated by measuring the elevations of raised beaches.

Sample preparation and analyses are currently under way. So far, partial data exist for the gossan and till samples from Ferguson Lake and for the reconnaissance till samples from the Yathkyed and Contwoyto Lakes areas.

Significant levels of platinum and palladium were found in the Ferguson Lake gossan, but there appears to be only limited dispersal of these elements in the till down-ice from the mineralization.

Reconnaissance (1 sample per 9 km^2) till geochemical data portray clearly the gold-bearing units within both the Yathkyed and Contwoyto Lakes areas. The newly observed sequence of ice flow directions, related to the Keewatin Ice Divide, in the Yathkyed Lake area suggests that glacial transport from mineralized zones and hence, the details of geochemical patterns, may be complex. Reworking of till and other surficial sediments in Glacial Lake Contwoyto could affect the results of lake sediment and soil geochemical surveys by distorting or suppressing element levels or dispersal patterns.

TUNDRA GOLD VENTURE, NWT, AN UPDATE

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The Tundra Gold Venture, a joint effort between Noranda Exploration Company (51%) and TOTAL Energold Corporation (49% - formerly Getty Resources Limited), is located approximately 130 miles northeast of Yellowknife within the Courageous Lake Volcanic Belt of Archean Age. The property consists of approximately 24,000 acres covering nearly 50% of the southern portion of the Courageous Lake Volcanic Belt. Noranda commenced exploration activity in the area in 1976 with subsequent ground acquisition. In 1979, the joint venture partnership was formed and work continued towards base metals identification until 1980 when emphasis shifted to gold exploration. In 1982, a limited diamond drilling program located in the central portion of the property resulted in an intersection of 0.20 oz/T Au over a core width of 23 ft. Since that time, detailed exploration activity has taken place and resulted in the delineation of a new, major gold deposit.

Based on 158,000 ft. of diamond drilling from surface completed since 1982 on the Tundra Deposit, TOTAL Energold has estimated a potential in-situ inventory of 32.5 million tons grading 0.20 oz/ton Au at a cut-off of 0.12 oz/ton Au. The deposit is estimated to contain 6.5 million ounces of gold and remains open along strike and at depth.

The Tundra deposit lies within steeply-dipping, felsic pyroclastic and epiclastic rocks of the Matthews Lake volcanic Complex where the Courageous Lake Volcanic Belt attains its maximum thickness. Gold is concentrated in a series of parallel, near-vertical mineralized shear zones. The mineralized zones occur within an area up to 600 ft. wide over a strike length of 5,000 ft. and locally extend to a depth of 4,000 ft. Gold occurs primarily in association with acicular arsenopyrite and to lesser degree with pyrite and pyrrhotite. Alteration features are sericitization, chloritisation and silicification.

In December 1987, the joint venture partners announced formal approval of a two-year, $35 million underground exploration program designed to confirm the deposit's continuity, mineability and economic viability. Included in the two-year program is a temporary headframe and hoist to facilitate sinking a 1,500 ft. vertical shaft which will be followed by cross-cuts and drifts from which another 50 - 60,000 ft. of closely-spaced underground definition drilling will be completed. Bulk sampling of several gold-bearing zones, further metallurgical testing, and a feasibility study will follow.

GEOLOGY AND STRUCTURE OF ALGOOD CLAIMS, REGAN LAKE AREA

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Gold is associated with quartz-chlorite-arsenopyrite-pyrite stringers, veins and pods that are structurally controlled within a folded package of Archean Beechey Lake Group mudstone-greywacke turbidites and iron formation, interbedded with minor andesitic feldspar-porphyroclastic tuffaceous horizons of the Back River Group, along the northeast flank of the Back River Caldera Complex.

Three phases of deformation, and low grade metamorphism transgressing the biotite isograd, have been identified. Large, map-scale tight to isoclinal F_1 folds show a wavelength and amplitude of 1 km, accompanied by a well developed northwest striking cleavage and, locally, a coarser schistosity in fine-grained phyllosilicate rich rocks. F_1 folds are overprinted by a schistosity that is not axial-planar to F_1 folds or to congruent minor structures. This later schistosity is generally northwest striking at a slight angle to the earlier cleavage. Minor folds, parasitic to F_1 folds, have been mapped intermittently along limbs of F_1 folds. Mesoscopic F_2 folds, affecting early cleavages only locally, are poorly defined due to lack of exposure, hence few structural measurements. Cross-folding is indicated by re-folded folds, observed in frost-heaved blocks, commonly found near major fold closures. It is also inferred from interference patterns on ground and airborne magnetic surveys. Cross folding is interpreted as broad open folds with sub-horizontal fold axes.

Linear surface depressions coincident with disruptions or dislocations seen on ground and airborne geophysical plots are interpreted to be fault or shear zones. Drilling supported this interpretation on Zone 3 where a north-northwest trending shear zone (Red Shear) was intersected.

Three mineralized zones were identified by prospectors in 1945, including two that are current exploration targets. These are near the noses of tight to isoclinal northwest plunging synclines whose axial planes strike of 080° to 100°. A property wide plot of mineralized surface samples, outcrop and frostheave, suggests these showings are stratiform as they are consistently within iron formation - tuff horizons, in the area of fold noses.

Close examination of Zone 3 shows an increase in apparently stratiform mineralized surface samples from west to east, along the south limb towards the syncline axis, until the north-northwest trending Red Shear is encountered. There is a very noticeable increase in frequency of samples along the southwest side of this fault/shear zone, whereas the northwest side, immediately adjacent to the fault, is almost void of mineralized samples.

Three drill programs have returned numerous anomalous gold intersections. The best results, +10 g Au over +2.5 m (T.W.), appear coincident with local, small scale parasitic folds that are sub-parallel to, and on the southwest side of, the Red Shear.

Parasitic folds have been observed at Zones 1 & 3. However, mapping and geophysics at Zone 1 have not identified hinge lines to parasitic folds, nor fault structures cross-cutting stratigraphy similar to Zone 3. Well mineralized intersections at Zone 1 do not reach 2.5 m (T.W.).

Gold mineralization on the Algood claims appears to be epigenetic and hosted in chemically suitable stratigraphic units, dilatant zones and along some faults. At Zone 3 significant thicknesses of gold mineralization, intersected in drill core, lie along hinges of anticlinal folds parasitic to major F_1 folds.

Gold deposition is related to late stage hydrostatic cycling of mineralized fluids along bedding slip fault zones (eg. Red Shear) as they transgressed and propagated through fold nose during F_1 folding. Periods of high hydrostatic pressure, following locking of the fold/fault process, result in fracturing and mineralization at suitable chemical/ structural sites.

PALEOSOLS AND DIAGENESIS OF THE THELON BASIN

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Altered zones beneath siliciclastic sediments of the Thelon Basin represent paleosols rather than zones of diagenetic alteration or low-grade metamorphism produced by post-burial unconformity-controlled circulation of groundwater and/or hydrothermal fluids. Evidence for this is provided by an abundance in the overlying siliciclastic sediments of silcrete clasts derived from upper parts of the underlying alteration zone. Many of these clasts, some up to boulder size, exhibit distinctive pedagenic characteristics identical to those preserved in uneroded patches of silcrete that locally cap the sub-Thelon alteration zone. Even though the alteration zone has been subjected to substantial modification as a result of burial diagenesis and migration of hydrothermal fluids, resulting in the growth of illite and chlorite from Kaolin precursors, much of the sub-Thelon alteration zone can be ascribed to Proterozoic pedogenesis. Analyses of typical profiles developed on granitoid protoliths show upward depletion in Al_2O_3, TiO_2, K_2O, Na_2O, CaO, FeO, MgO, MnO and P_2O_5, and upward enrichment in SiO_2 and Fe_2O_3. Upward ferric oxide enrichment and the depletion trends are similar to trends in modern saprolite profiles developed under hot and humid conditions. The upward silica enrichment correlates with silcretization, a process that recurred during deposition of the overlying Thelon sands. Silcrete films, some containing possible evaporite pseudomorphs, commonly occur along bounding surfaces in aeolian dunefields of the Thelon Formation, supporting the probability that silcretization marks a change from hot and humid conditions before Thelon sedimentation to arid conditions that continued during much of Thelon sedimentation.

Abundant sand-size grains of silcrete, in association with numerous silcrete layers within the Thelon Formation, suggest that accretion of the Thelon siliciclastics involved a complex interplay of sand deposition, silcretization and reworking. Dominated in the Thelon Basin by fluvial and aeolian transport after prolonged episodes of chemical weathering, these processes can account for the extreme compositional maturity of Thelon siliciclastics that paradoxically show widespread textural immaturity.

BEAR PROJECT, SUNRISE LAKE AREA

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Industries Ltd.

Three significant polymetallic massive sulphide deposits have been found in the Sunrise Lake area, 110 km northeast of Yellowknife. These include two (M zone) discovered by a Silver Hart Ltd./Ark La Tex Industries Ltd. joint venture and one discovered by an Aber Resources Ltd./ Hemisphere Development Corp. joint venture. These deposits are hosted within structural sub-basins in a mixed sequence of greenschist metamorphic grade mafic and felsic volcanics and related sediments. Alteration associated with the deposits is generally weak and includes addition of silica, calcium, aluminum, potassium, and magnesium. Mineralogy of the deposits is relatively simple with sphalerite, galena and pyrite comprising the bulk of the sulphide minerals. Less abundant sulphides include arsenopyrite, marcasite, chalcopyrite, tetrahedrite, sternbergite, pyragyrite and argentite. Native silver and gold are also present. In general the ratio of zinc to lead is 3:1 with variable silver and gold values and negligible copper content. Metal contents in the massive sulphide zones on Silver Hart Mines Ltd./Ark La Tex Industries Ltd. Bear Project range up to 34.5% Zn, 18.6% Pb, 63.2 oz/T Ag and 0.57% Cu. A geological resource of 809,700 tons grading 0.026 oz/T Au, 6.41 oz/T Ag, 2.32% Pb and 6.11% Zn to a depth of 400 m for the M zone has been calculated by our consultant.

NEW IDEAS ABOUT YELLOWKNIFE VOLCANIC BELT STRATIGRAPHY: GIANT SECTION, YELLOWKNIFE

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The stratigraphy of the Giant Section, specifically the nature of the Kam Group-Banting Group boundary and the position of the Jackson Lake Formation, must be reconsidered in light of detailed field mapping and closely spaced geochemical data.

Instead of an abrupt unconformable change from mafic to felsic volcanism, the Giant Section demonstrates a transitional sequence. Multiple dykes feeding pillowed flows and gabbroic sills in the Kam Group can be traced into the Banting Group, where they feed gabbro sills and massive flows. Felsic volcanism is first marked by rhyodacite boulders in the "Bode Tuff", a re-sedimented volcaniclastic unit, that occurs well below the traditional Kam-Banting

boundary. Interbeds of sandstone rich in felsic fragments provide further evidence of increasing felsic volcanism higher in the succession. The progression is capped by felsic ash beds and ignimbrites interbedded with mafic flows. A felsic dyke has been identified as a potential source of the felsic flow units and associated tephra deposits.

The transitional sequence is complicated by a local occurrence of the Jackson Lake Formation. Coarse conglomerate of this unit rests unconformably on a regolithic sequence in a paleo-valley that is inferred to cut from above the Banting into the Kam-Banting Group transitional zone. Later faulting and the development of a strong foliation in weathered rock has obscured the contacts, but according to the interpretation presented here, faulting need not be invoked to explain the position of the Jackson Lake Formation "below" the Banting Group in this locality.

This clarification of relationships simplifies the incorporation of the Giant Section into the stratigraphy of the Yellowknife Volcanic Belt.

METAMORPHIC GOLD CONCENTRATION IN ARCHEAN IRON FORMATION, SLAVE PROVINCE

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Gold-bearing iron formations in the Slave Structural Province are hosted within thick turbidite sequences that were subjected to a protracted history of deformation and metamorphism. Bordering metasediments record peak metamorphic conditions of 550°C and 2.5 kb. Known economically significant gold occurrences are sited at regional fold closures. Two facies of iron formation are recognized at gold occurrences: (1) competent amphibolitic iron formation characterized by a prograde metamorphic assemblage of quartz + grunerite + hornblende ± garnet + graphite + ilmenite + pyrrhotite; and (2) incompetent pelitic iron formation consisting of quartz + biotite + garnet + grunerite + hornblende + ilmenite. Both facies show that grunerite crystallization was followed by hornblende and garnet. The replacement of grunerite by hornblende and garnet in fold hinges provides evidence for the migration of metamorphic fluids. Concentration of this hydrous fluid caused overpressuring and hydrofracturing of the relatively brittle amphibolitic iron formation. The high fluid pressures caused silica dissolution coincident with metasomatic growth of hornblende and garnet. Pressure release stabilized zoisite, apatite, carbonate and locally ferroactinolite on the selvages of quartz veins. Gold was transported in the metamorphic fluid as reduced sulphur complexes. Migration of the fluids into hinges resulted in overpressuring and fracturing. Gold and associated metals were precipitated coincident with pressure release and sulphidation accompanying quartz veining. Mineralized hinge domains show evidence of retrogression by oxidized hydrothermal fluids but this late overprint did not further affect gold distribution.

PRELIMINARY MAPPING IN THE HOPE BAY METAVOLCANIC BELT, NORTHEASTERN SLAVE PROVINCE

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The Archean Hope Bay metavolcanic belt is in the extreme northeastern portion of the Slave Province (Bathurst Block). This elongate belt extends southeastward for 80 km from the shore of Melville Sound. A smaller 60 km long metavolcanic belt (Elu belt) lies 20 km to the east. (A three year MDA project is proposed to map these belts.) The southern third of the Hope Bay belt (NTS sheets 76 O/9, 10, 15, 16) was mapped at a scale of 1:50 000 during 1988.

Basaltic to andesitic pillowed and massive flows together with gabbro sills comprise approximately 70% of the southern Hope Bay belt. Pillowed flows are commonly intensely sheared and have been variably silicified, carbonatized and chloritized. Felsic volcanic rocks comprise the remaining 30% of the area and include subvolcanic intrusions and flows of massive and porphyritic dacite and rhyolite. Coarse felsic fragmental volcanic rocks, tuff and lapilli tuff are locally present. Sedimentary rocks (graphitic mudstone and wacke) and ultramafic rocks (peridotite) are rare in the area mapped but are more common towards the north. Diabase dykes transect both the volcanic belt and adjacent granitoids. Outliers of the Proterozoic Goulburn Group (conglomerate and quartzite) unconformably overlie the Hope Bay belt along Melville Sound.

The southern Hope Bay belt is characterized by a strong, subvertical north-northwest trending regional foliation. This foliation deviates from north-northwest along the eastern margin of the belt adjacent to a granitic intrusion, and, along the southern contact of the belt. Pillow elongation, shearing and lithologic contacts are mostly subparallel to the regional foliation. Elongation of pillows coupled with pervasive shearing generally obscure top indicators. In combination with a local paucity of outcrop, this inhibits reconstruction of the volcanic stratigraphy. However, reversals in pillow facings suggest faults or isoclinal folds. Large-scale fold closures are not apparent in outcrop although minor folds which fold the regional foliation and plunge moderately to the north or south are developed locally. Certain areas of the belt also exhibit sets of east trending, sub-vertical closely spaced fractures.

Contacts between the metavolcanic belt and the adjacent granitoid terranes range from structural to intrusive. Mylonitic zones are developed in felsic volcanic rocks adjacent to foliated granites along the western margin. The eastern margin is marked by a broad transition zone in which mafic volcanics are progressively transformed to amphibolites and are increasingly intruded by granitic to granodioritic dykes. The transition zone and the belt of rocks extending eastward towards the Elu metavolcanic belt have previously been mapped as migmatites.

Exploration in the Hope Bay belt has focused on: (1) high-grade native silver veins in east trending fracture sets close to diabase sills; (2) volcanogenic massive-sulphide deposits; (3) small, high-grade auriferous quartz veins; (4) auriferous quartz-carbonate shear zones in pillowed flows; and, (5) auriferous shear zones along the granite-greenstone contact. At present, the most promising

deposit type in the southern Hope Bay belt appears to be the auriferous quartz-carbonate shear zones (eg. Spyder claim).

THE MYTH OF THE MACKENZIE SHALE BASIN AND OTHER MISCONCEPTIONS, PINE POINT LEAD ZINC DISTRICT

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Numerous reports, dealing with the Pine Point District, postulate a Middle Devonian shale basin north of the Pine Point barrier reef as a source of metal-bearing brines by means of a model proposed by Noble (1963). The concept of the Mackenzie Shale Basin was started by Jackson and Beales (1967), who relied on Grayston et al. (1964) for regional geology. Unfortunately, they modified figure 5-11D of Grayston et al., so that thin carbonate north of the reef became shale and the south Mackenzie (River drainage) basin became the McKenzie (sic) sedimentary) Shale Basin, (Fig. 1 of Jackson and Beales, 1967). **There is no such shale basin!**

Simple projection of the West-southwest trending Precambrian McDonald Fault or Great Slave Lake Shear Zone through the Pine Point area has been used to argue both for and against a genetic relationship to ore deposits. However, these arguments fail to account for the complex nature of the basement as shown by aeromagnetics, or the role of Paleozoic tectonics or north-northwest trending structures.

Despite the recent dismantling of the mining operations and town of Pine Point, considerable quantities of zinc and lead remain and exploration potential is good. Social, political, economic, environmental, and hydrology problems stand in the way of profitable mining of the remaining half of the district's mineral resources.

GEOLOGY OF THE PISTOL BAY/WHALE COVE AREA; RANKIN-ENNADAI GREENSTONE BELT

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A section across the northeast end of the Rankin-Ennadai greenstone belt (55K/7 and l0, 2 NE, 11E and parts of 6 and 9) was mapped at 1:31,680 during 1988. The area is underlain by the Archean Kaminak Group which comprises two mafic metavolcanic units and two metasedimentary units. These units, which are not seen in stratigraphic contact are described in order from south to north.

1) A west-facing metavolcanic unit at Whale Cove is composed predominantly of pillow basalts with ubiquitous plagioclase phenocysts, minor pillow breccia and minor, interlayered, 1 m-thick chert beds containing thin magnetite bands.

2) A southwesterly-dipping homoclinal sequence of turbiditic metasediments comprises two main lithologies: a repetitive sequence of graded units of lithic-arenite, wacke, siltstone and slate with rip-up clasts, intraformational conglomerate and magnetite-chert bands plus a unit of thickly-bedded massive lithic arenite. Minor chert-magnetite bands, mafic volcanic flows and felsic agglomerates are found in the upper part of the sequence.

3) A 35 km-long belt of west to southwesterly facing, non-porphyritic mafic metavolcanic flows is found north of Pistol Bay. This is predominantly pillowed with subsidiary massive flows and minor variolitic massive flows. No pillow breccia was observed. Subvolcanic lenticular domes of quartz-feldspar and feldspar-porphyritic rhyodacite are common. The regional metamorphic grade increases from low (greenschist facies) to medium (amphibolite facies) towards the north and west.

4) A northeasterly trending belt of schists shows fine-scale interlayering of quartz-feldspathic and garnet-biotite schists (±kyanite and sillimanite), suggesting medium-grade metamorphism of a turbidite sequence. However, this metasedimentary sequence contains numerous, thin magnetite bands and therefore differs from that just north of Whale Cove.

Porphyritic biotite-adamellite to biotite-hornblende-granodiorite plutons, up to 10 km across, intrude this supercrustal sequence, and display sharp contacts, stoping and veining. Further north, with increasing metamorphic grade, these plutons become foliated and sheared and eventually form a migmatite zone with biotite-quartz gneiss and later veins of pink granite. Ripple-marked, white to pink orthoquartzite of the Proterozoic Hurwitz Formation unconformably overlies the Kaminak Group in the centre of the mapped region.

In the Pistol Bay area, two pervasive sets of brittle shear, with accompanying chlorite and silica, are recognized. One trending 155° and dipping 75°W (S_1), is offset sinistrally by a set trending 085° and dipping 65°N (S_2), which also postdates the adamellite intrusions. Both sets of shears have an associated parallel fracture cleavage.

Numerous gossans in mafic and felsic metavolcanic hosts are caused by pyrite-chalcopyrite and pyrrhotite-chalcopyrite mineralization associated with S_1 and S_2. Quartz-calcite and quartz-dolomite pods and veins display a variety of trends but are closely associated with S_3. These may contain pyrite, chalcopyrite, galena, or gold. Several sets of quartz veins are developed but pyrite and chalcopyrite tend to be associated with a 060° trending set. In the Whale Cove area, quartz veins may contain molybdenite and gold.

THE DETERMINATION OF Au, Pt, Pd AND Rh IN VEGETATION AND WATERS COLLECTED FROM FERGUSON LAKE, KEEWATIN DISTRICT

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The objective of this study was to investigate the uptake of Au and PGEs in vegetation, growing in an area known to be anomalous in base-metal and PGE content, and to compare the response in the vegetation with that in the tills. The field location was Ferguson Lake, NWT, about 150 km north of the tree-line in a zone of typical Arctic tundra of dwarf shrubs and low plants.

Approximately 150 sites were sampled for glandular birch (Betula glandulosa) and Labrador tea (Ledum groenlandicum) along the gossan for about 2 km, 200 m up-glacier of the gossan and up to 2 km down-glacier of the gossan. Samples were separated into leaf and twig tissue, 8 g taken for multi-element analysis by neutron activation (NAA) and the remainder ashed at 470°C in preparation for the determination of Au, Pt, Pd and Rh.

Part of this project comprised the development of a method designed to reach detection levels for Au, Pt, Pd and Rh of 1-2 ppb on a 1 g weight of ashed sample. The minimum sample weight currently required for such detection levels is 10 g (equivalent to about 1 kg dry weight) making biogeochemical exploration for these elements not only impractical but impossible in areas such as this, sparse in abundance of plant material. The method developed involves further ashing to 870°C, leaching with HF - aqua regia, separation of analytes by co-precipitation on Te and analysis of the final digest by ICP - mass spectrometry (ICP-MS). Accuracy has been confirmed by comparison of results for control samples at higher analyte concentrations with independent methods such as NiS fire assay/NAA and Pb fire assay/ ICP-MS. The homogeneity of the sample in Au, Pd and, particularly, Pt distribution is the dominant factor in the precision obtained. A small study was carried out to lower detection limits obtained for all PGEs by conventional NiS fire assay /NAA using a 1 g sample weight. While results were encouraging, the necessary changes to the routine procedure would lead to an undesirable high cost of about $300 per sample. A method was also developed to determine Pt and Pd down to 0.2 ppt in one-litre water samples. The analytes are concentrated by adsorption onto activated charcoal, ashed and the final digest analyzed by ICP-MS.

Preliminary results from the study illustrate that glandular birch and Labrador tea accumulate high levels of Au, Pt, Pd and Rh. For example, in ashed samples of birch twigs, Pd values range from 6.4 to 3,071 ppb, Pt values range from <2.0 ppb to 135 ppb, and Rh values range from <1.0 to 104 ppb. The high values represent samples that were taken from the gossan. The lower values represent samples that were taken either in the zone of material that was glacially derived from the gossan or from the 'background' zone that was up-glacier from the gossan. The chemical analyses, although currently incomplete, indicate that the PGEs remain at elevated levels for at least several hundred metres in the down-ice direction. The zone of dispersal appears to be defined best by levels of Pd in birch twigs.

Water at a pH of 3.0, collected over the gossan, contained significant Pd at 1.5 ppt. Interestingly, less acidic water nearby at pH 4.4 and 16 ppm SO_4 (as compared to 140 ppm SO_4 in the former water) contained 2.0 ppt Pd and 2.8 ppt Pt. Palladium and platinum were not detected in streams away from the gossan.

In summary, the vegetation in the region of the gossan at Ferguson Lake has been shown to take up Au, Pt, Pd and Rh at concentrations orders of magnitude above the background of less than 2 ppb (ash weight). Such mapping would have been impossible using conventional analytical methodology as most samples were of 1 g weight or less, well below the minimum weight usually required of 10 g. Application of the newly developed method to determine Pt and Pd to 0.2 ppt in waters has shown there to be a measurable response in waters in contact with the gossan.

[1] The determination of Au, Pd and Pt in ashed vegetation by ICP - mass spectrometry and graphite furnace atomic absorption spectrometry. J. Geochem. Explor. G.E.M. Hall, J.C. Pelchat and C.E. Dunn, in press

GEOLOGY OF THE RUSSELL-SLEMON LAKES AREA (85O/4)

by V.A. Jackson
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Russell-Slemon Lakes area is about 100 km west-northwest of Yellowknife, in the southwestern Slave Structural Province. The area is underlain by Archean supracrustals that are continuous with the Indin Lake belt to the north. Supracrustal rocks are characterized by abundant sediments, with lesser felsic and mafic volcanics.

Sedimentary rocks constitute two distinct lithologies defining a greywacke-mudstone sequence: a thick bedded sandstone-greywacke dominated unit and a thin bedded siltstone-mudstone dominated unit. The latter contains sulfide-rich, locally auriferous amphibolitic sediments similar to Lupin-type iron formation (BUGOW and SP claims).

Mafic volcanics form thin, elongate units within the sedimentary succession and also are locally auriferous (MOS claims). In the western Russell Lake area volcanics comprise 600 to 1,500 m of interlayered pillow basalts, pillow breccia, gabbro, minor felsic fragmentals and felsic dikes. This basaltic sequence is both overlain and underlain by greywacke-mudstone.

Felsic volcanics on the east side of Russell Lake form a dacitic centre similar to the Clan Lake dacite dome complex (Hurdle, 1985). These volcanics consist mainly of massive and fragmental dacite. Limestone, intermediate fragmentals, volcaniclastics, chert and pelitic sediments are interlayered with the dacitic volcanics along the margins of the centre. Several small felsic intrusions are noted within the sediments and basalts south of the Snare River. A quartz vein associated with one of these intrusions contains about 5 g/t Au.

Felsic dikes are abundant within sediments of the western Russell Lake area, but are minor adjacent to the dacite complex.

Mafic dikes, typically less than 3 m wide, intrude greywacke-mudstone sediments and are abundant adjacent to western Russell Lake basalts. These dikes lack relict igneous textures, are metamorphosed and typically strongly foliated. In several locations mafic dikes are found together with felsic dikes, and some appear to have used the same conduits during intrusion.

Two subsequent phases of gabbro and diabase dike emplacement are documented. The oldest dykes range in width from 1 to 70 m and are metamorphosed but little deformed, such that igneous textures have been retained. The youngest, likely Proterozoic, are unmetamorphosed and undeformed, although they may be brecciated in fault zones.

Batholiths and plutons of granitic composition intruded the supracrustal succession. Characteristically, they are homogeneous coarse-grained mica granites, with only local and minor variations to porphyritic, pegmatitic or fine grained texture. However, granitic intrusions along both the eastern and western edges of the map area have contaminated marginal phases, consisting of hornblende-biotite granodiorite-tonalite and fine grained biotite granodiorite respectively. Sedimentary xenoliths and screens are common in many of the granites. A granitic pluton in the Cabin Lake area is unusual in that it is fluorite-bearing. A small body of fine grained, plagioclase phyric granodiorite-tonalite has intruded sediments in

the Slemon Lake area. South of Murky Bay a granodiorite stock (Sevenore Stock) contains veins that are locally auriferous. Easterly trending pegmatite dikes are abundant in sediments and basalts north of Murky Bay and south of Mosher Lake. Pegmatites typically contain muscovite and black tourmaline and less commonly garnet, spodumene, lepidolite or lazurite(?).

Metamorphic grade ranges from greenschist (below biotite zone) to amphibolite facies. The higher grade rocks contain cordierite, andalusite and possibly sillimanite. Below the cordierite isograd the metasediments locally contain biotite porphyroblasts, but these porphyroblasts are more typical in cordierite-bearing schists. Cordierite porphyroblasts increase in length from <0.5 cm to >5 cm over a short distance from the isograd. Garnet and amphibole are presently in both greenschist and amphibolite facies iron-rich metasediments, with garnet first appearing just below the cordierite isograd.

Metabasites in both western and eastern areas have undergone amphibolite facies metamorphism. Metamorphic grade of the dacites on the east side of Russell Lake is difficult to determine. While these siliceous rocks contain combinations of muscovite, chlorite, biotite, amphibole and garnet, the distribution of these metamorphic minerals may reflect variations in bulk composition rather than changes in the physical conditions of metamorphism.

Regionally the isograds are subparallel to the borders of granitic batholiths. In eastern and northern areas amphibolite facies metasediments form a narrow zone adjacent to granitic batholiths; the western and southern areas are underlain by a much wider expanse of amphibolite facies rocks and the southern Russell Lake area (NTS 85J/13) is entirely within amphibolite facies. Greenschist facies metasediments form narrow "troughs" between the higher grade rocks in the Cabin Lake, Bousso River and eastern Russell Lake areas. A decrease in size and abundance, and in some cases a total lack of cordierite porphyroblasts in metasediments adjacent to granite " bodies suggest the granitic intrusion was accompanied by host rock alteration. Similarly, on a smaller scale, cordierite-free halos surround some quartz veins and mafic dikes within the metasediments.

Peak metamorphic conditions postdate the establishment of the major structural features as the cordierite isograd transects both bedding and foliation trends.

At least three phases of folding are established. Mesoscopic F_1 folds have been observed in several locations but their initial orientation is uncertain due to reorientation by later F_2 folds.

F_2 folds, the most obvious folds, are documented mainly through reversals in bedding facing direction; observations of fold closures are rare. F_{2A} folds, long limbed, isoclinal folds, have north-trending axial traces and steeply plunging axes. Axial traces of F_{2A} folds are typically traced for distances of less than 1 km to 2-3 km and are overturned in panels. Overturning is generally away from nearby batholiths, such that folds are overturned to the east in the western Russell Lake area, but to the west throughout most of the remaining area. Axial traces vary along their length from upright to overturned. An axial plane cleavage (S_2), variably developed in the hinge zones of F_{2A} folds, forms a weak mica alignment or a segregation cleavage defined by wispy, micaceous or calcareous concentrations or by alignment of sedimentary structures (eg. sandstone balls). Injection of quartz veinlets into the S_2 cleavage orientation is common.

F_{2B} folds are similar in style to F_{2A} folds but have east-trending axial traces and are overturned either to the north or south. F_{2B} folds within the thin bedded sediments of Murky Bay and western Russell Lake areas appear to butt against the limbs of F_{2A} folds defined within the thickly bedded sediments. F_{2B} fold facing directions are consistent with younging directions on the limbs of F_{2A} folds. Both northerly and easterly fold sets may have formed during the same folding event which involved disharmonic folding along detachment surfaces (eg. the interface between thick bedded and thin bedded sediments).

A third phase of folding (F_3) resulted in regional scale warping of F_2 axial traces about east-northeast and west-northwest axes and is the only phase of macroscopic folding associated with regional foliations.

Three regional foliations (cleavages or schistosities), which postdate F_1 and F_2 folds, are defined: an early formed north-trending foliation (S_3) and two later foliations with northwesterly (S_4) and easterly (S_5) trends. The foliations have a patchy or zonational distribution: S_3 predominates in the central part of the map area, S_4 is the main fabric recorded in the north western map area and S_5 is best developed in eastern areas. All three cleavage subsets are associated with mesoscopic folds (F_3) and large scale open F_3 folds likely formed in association with S_4 and S_5 foliations (see above). In many of the higher grade metasediments the only foliation present is a bedding parallel biotite-muscovite schistosity of either S_2 or S_3 generation.

Quartz vein injection was initiated prior to, and outlasted fold and cleavage formation. The variation in vein type with relative age of emplacement is similar to that described by Fyson (1987). Quartz veins were also emplaced along post-Archean fault zones.

Although supracrustal rocks in the Russell-Slemon Lakes area are comparable to those of both the Yellowknife and Indin Lake belts there are notable differences: 1) Lupin-type iron formation, abundant at Russell Lake, is not present in the Yellowknife or Indin Lake belts and 2) the mafic and possibly the felsic volcanic sequences at Russell-Slemon Lake appear to have been extruded within the sedimentary succession. While a similar relationship is observed in the Indin Lake belt and some other supracrustal belts of the northern Slave Province, this contrasts with the Yellowknife Belt stratigraphy, where volcanic sequences are typically marginal to the sedimentary succession.

Russell-Slemon Lakes area has high potential for gold. Gold showings are noted in almost every rock type and in both Archean and Proterozoic settings.

GEOLOGY OF THE YELLOWKNIFE SUPERGROUP AND THE SLEEPY DRAGON COMPLEX NORTH OF FENTON LAKE, SLAVE PROVINCE

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Contribution to Canada-NWT
Mineral Development Agreement
Project carried by
Geological Survey of Canada

North of Fenton Lake, supracrustal rocks of the Yellowknife Supergroup and rocks from the Sleepy Dragon Complex, which are considered to be possible basement to the Yellowknife Supergroup, can be subdivided into three lithologic-structural domains. The domains are composed of: gneisses and metaplutonic rocks of the Sleepy Dragon Complex and unmetamorphosed porphyritic granite, metavolcanic rocks of the Cameron River belt, and metamorphosed greywacke-mudstone turbidites of the Burwash Formation. The contact between the Sleepy Dragon Complex - porphyritic granite domain and the Cameron River metavolcanic domain is everywhere tectonic, marked by moderate to steep, west-southwest to west-northwest dipping, ductile shear zones that contain oblique to down-dip mineral elongation lineations. Kinematic indicators from ductile-strained rocks along the contact indicate west-side-down kinematic sense. This suggests that the Sleepy Dragon Complex may have been tectonically unroofed by postporphyritic granite, ductile, normal faults that followed the lower contact of the Cameron River belt.

STRATIGRAPHIC AND STRUCTURAL SETTINGS OF IRON-FORMATION AND GOLD IN THE BACK RIVER AREA, DISTRICT OF MACKENZIE

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Canada-NWT Mineral Development Agreement

The volcanic Back Group and the overlying sedimentary Beechy Lake Group are interfingered and punctuated by three ferruginous chemical sedimentary sequences (CSS). The lowest CSS is sulphide-dominated and volcanic-hosted; the highest is oxide-dominated and sediment-hosted. The middle, most auriferous CSS comprises iron-carbonate-cemented volcanic breccias and grits, overlain by oxide facies iron-formation, in turn overlain by sulphide facies iron formation and slates which are intercalated with discontinuous volcanic and shallow intrusive rocks. The main folds (F_2) are large and open in volcanic units; parasitic similar folds of various sizes in sedimentary units are tight and moderately to steeply plunging. Axial planar crenulation cleavages (S_2) are sub-parallel to the limbs of the large folds. Shallowly and steeply plunging kink folds (F_3, F_4?) and associated fracture cleavage trend northerly and northwesterly. The most auriferous units are grey, sulphidic, crack-seal quartz veins that are stratabound within the middle CSS and were deformed by F_2 folds.

GEOLOGY OF THE TORP LAKE AREA, WESTERN BATHURST INLET (76 N/5, 6)

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GNWT, Canada-NWT Mineral Development Agreement

The Torp Lake area in the northern Slave Province is underlain by Archean metasediments and granitoids and, Proterozoic diabase dikes (Mackenzie Dike Swarm). Previous mapping in this area was part of a GSC helicopter-assisted reconnaissance of the northeastern Mackenzie District, which produced a 1:506,880-scale map (Fraser, 1964). Geological mapping at a scale of 1:30 000 during the 1988 is part of a three year MDA project to map areas of gold potential in the lower Hood-James River region.

Torp Lake is situated at the western edge of a triangular belt of Yellowknife Supergroup metasedimentary rocks bordered by a granitic terrain to the west and south and the north-northwest trending Bathurst fault system to the east edge (Figure 1). The Proterozoic Goulburn Group underlies the area further east. The contact between the plutonic complex and the supracrustal rocks is extremely irregular with lobes of granite and granodiorite partially or completely enclosing slivers of country rock up to 1 km long along the western contact. The long axes of the enclosed slivers are oriented north, sub-parallel to the strata. Granitic magma appears to have intruded as sheets along bedding planes without rotating the strata. Rare xenoliths of metasedimentary rock and amphibolite tend to be more common close to the edges of the intrusive complex.

The turbidites comprise thin to moderately bedded fine-grained wacke, laminated and thin-bedded mudstone and siltstone and minor pebbly wacke. Sedimentary structures, including cross-laminations, cross-beds, slumps and scours, are common despite deformation and high metamorphic grade (cordierite-amphibolite facies). Most metapelites contain porphyroblasts of cordierite or chiastolite or both.

A 1 to 4 km wide, northwest-trending gneiss belt, extending from the James River to Kunes Lake, is truncated by granite along its southern and western edges (Figure 2). The belt consists of discontinuous bands of paragneiss grading into metasediments typical of the rest of the region. An elongate granodiorite stock and tonalitic and pegmatitic dikes have intruded parallel to bedding. Throughout the belt, narrow tonalitic dikes intrude along bedding planes but the younger pegmatite dikes, bearing muscovite schorl and spodumene, are usually more irregular and discordant.

The massive, fine- to medium-grained tonalitic dikes increase in number towards the western granite-metasediment rock contact until dikes account for over 40% of the rock. It is not clear whether these 0.l-10 m wide, quartz-albite dikes represent products of metamorphic differentiation or anatexis, partial melting of the country rock and injection into a zone of brittle fracturing at the edge of the granite.

In the northern half of the area, strata strike north to north-northwest and dip moderately to steeply on the limbs of tight to isoclinal, shallowly south-plunging folds (F_2) that have sub-vertical to steeply west-dipping axial planes. The folds appear to be several kilometres long but their

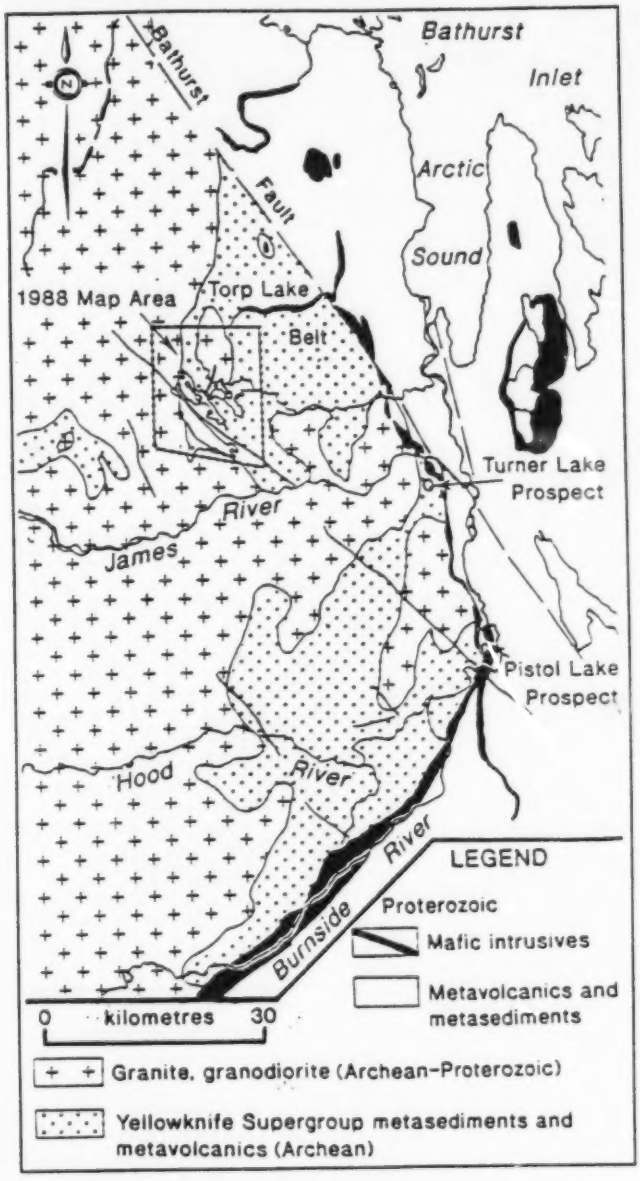

FIGURE 1: REGIONAL GEOLOGY

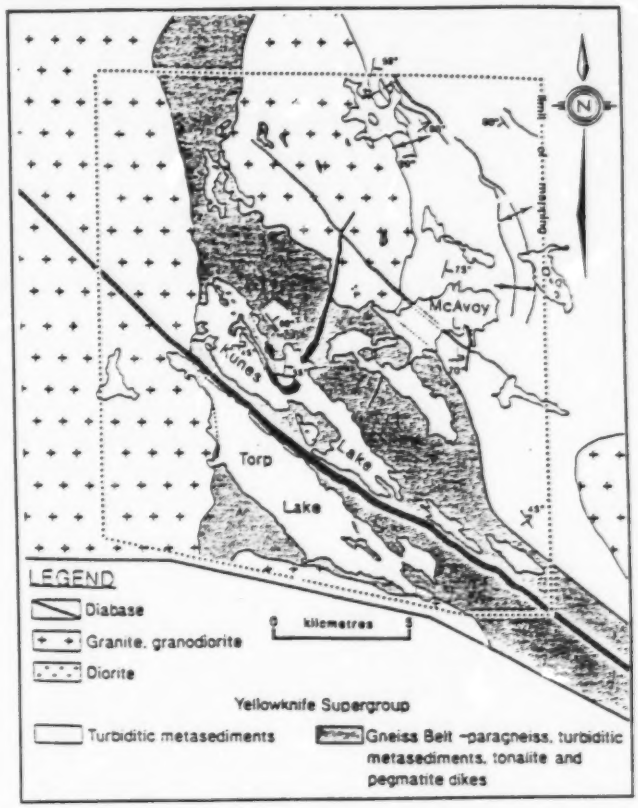

FIGURE 2: GENERALIZED GEOLOGY OF TORP LAKE AREA

continuity has yet to be confirmed. Strata strike northwesterly in the southern half of the area.

A bedding parallel fracture cleavage/schistosity (S_1) that predates these folds is deformed by a fine crenulation and 1-5 cm amplitude open folds (F_2) with steeply-dipping, east-striking axial planes. The folds plunge within 15° of vertical as does a faint stretching lineation defined by the long axes of deformed fine biotite porphyroblasts and pebbles. The pebbles are ellipsoidal with planes containing intermediate and major axes oriented subparallel to S_1. The minor folds and the lineation appear to post-date the end of the period of F_2 folding. An overprinting cleavage (S_4) in metapelite dips 45-60° southeast and forms a sub-horizontal intersection crenulation on the S_1 cleavage planes.

A few steeply northeast to east-plunging open folds with 10-150 m amplitudes, angular fold closures and northeast-striking, sub-vertical axial planes were found on the limbs of the F_2 folds. In addition, shallowly northeast-, east- and southeast-plunging, gentle to open folds with 1-20 m amplitudes were noted wherever shallow-dipping beds were exposed. The age relationships among the three different groups of post-F_2 folds is yet unresolved.

The metasedimentary rocks commonly contain disseminated, fine-grained pyrrhotite, arsenopyrite and chalcopyrite in low concentrations. However, pyrrhotite and particularly arsenopyrite become concentrated within narrow (10 m) gossanous lenses bordering quartz veins in the S_1-parallel fractures. Assays of random samples from such gossans yielded no significant gold or silver values.

Gold exploration in a second metasedimentary belt to the south has focused on: a thin metavolcanic succession characterized by basaltic flows, breccias, tuffs and an andesitic sill (C. Jefferson, GSC, pers. comm. 1988), west of Turner Lake; and, oxide and silicate iron formations near Pistol Lake (Chevron Ltd.-Silver Hart Joint Venture). Gold is hosted by quartz veins and stringers enriched in pyrrhotite and arsenopyrite and bordered by garnet-amphibolite alteration zones in the Turner Lake andesitic sill and at the base of an oxide iron formation at Pistol Lake. The greatest ore potential at both Pistol and Turner Lakes is found within the hinges of large steeply plunging folds with east-striking axial planes. These two folds are similar but much larger than the folds near Torp Lake. This structural association will be investigated with continuing work at the properties. As the MDA mapping project progresses in both belts, extra effort will be made to focus on the delineation of such folds and related

fracturing as well as the identification of iron formation in the stratigraphy.

Reference
Fraser, J.A., 1964, Geological notes on the northeastern District of Mackenzie, Northwest Territories, (Report and Map 45-1963), GSC Paper 63-40, 21 pg.

LATE QUATERNARY MARINE RECORD OF THE CAPE PARRY - CLINTON POINT REGION, MACKENZIE DISTRICT

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A preliminary investigation of stratigraphic sections and raised marine geomorphic features in the Cape Parry - Clinton Point area, north central District of Mackenzie has made it possible to reconstruct late glacial and post-glacial marine environments of deposition. In the early stages of deglaciation, recessional moraines, deltas and outwash fans were formed on Parry Peninsula as a result of the receding Amundsen Gulf lobe. Ice marginal lakes were impounded between this lobe and the more elevated terrain of the Melville Hills. Northward flowing streams built deltas into these lakes which were successively lowered or drained as the ice front retreated. Six lacustrine deltas were noted in the study area, varying in elevation between 61 m and 93 m a.s.l. The extent of these ice marginal lakes has not yet been determined.

Further shrinking of the Amundsen Gulf lobe resulted in the marine incursion from the west along its southern margin between Paulatuk and Clinton Point, inundating the coastal lowlands. This established the marine limit which is now marked by a series of perched deltas. The limit of marine submergence varies from approximately 46 m a.s.l. east of Clinton Point and decreases to the west, attaining 6 m a.s.l. near Cape Parry. This decreasing trend in elevation is the result of differential isostatic uplift which can be traced further east along the mainland coast. Few deltas are found below the marine limit of submergence, which suggests that the bulk of sedimentation took place in the early stages of the transgression, so that considerably less sediment was supplied by a smaller number of rivers during the marine regression.

Few radiocarbon dates are available in the study area, as samples have only been collected recently for dating. It is believed that sea level in the Paulatuk area was between 26 m - 6 m a.s.l. about 11 300 years BP and had regressed to below 2 m - 3 m a.s.l. by 9 600 years BP. Ongoing dating will help elucidate the temporal framework of the marine record.

GOLD DISTRIBUTION ON THE NORANDA/ TOTAL ENERGOLD TUNDRA PROPERTY COURAGEOUS LAKE AREA

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This poster session focuses on some aspects of gold distribution on the Noranda/TOTAL Energold (formerly Getty Resources Limited) Tundra property. The work is funded under Project C1.2.1 of the Canada-NWT MDA and is being done in co-operation with Noranda Exploration Company, Limited and TOTAL Energold Corp., whose support of the project is gratefully acknowledged. Work to date has made extensive use of core from seven surface exploration holes through the upper levels of several gold-rich zones on the property.

Megascopic examination of core slabs and microscopic examination of a limited number of polished sections from drill core indicate the following:

1) Gold is structurally controlled and occurs in, or adjacent to, fractures and/or veins in variably deformed and altered host rock. Only a small amount of gold occurs within well-developed quartz veins, a feature in marked contrast to the nearby Salmita deposit in which virtually all the mined gold was confined to a large discordant quartz vein (the B vein).

2) Some of the gold-bearing fractures and veins are complexly deformed.

3) Although metallurgical studies indicate that much of the gold is refractory and tied up within arsenopyrite, a significant amount of the non-vein hosted gold in the upper levels of the deposit is free or "visible". The average grain size is less than 10 µm with a maximum (to date) of 30 µm.

4) Free gold is very closely associated with arsenopyrite but not with pyrite or chalcopyrite (some arsenopyrite replaces early pyrrhotite, but much of the pyrite and chalcopyrite appear to post-date gold and arsenopyrite).

5) Despite the close spatial association between free gold and arsenopyrite, only some of the free gold is located within arsenopyrite (as inclusions or along fractures) or immediately adjacent to arsenopyrite. Much of the free gold is interstitial to silicates.

Statistical analysis of a set of major, minor and trace element data from 92 core samples of both mineralized and unmineralized rock indicates the following:

1) Gold is very strongly positively correlated with arsenic, less strongly correlated with sulphur, and not correlated with base metals.

2) Many auriferous samples have relatively great K_2O/Na_2O ratios probably generated during gold-related hydrothermal alteration.

3) Au/Ag ratios are widely variable and may be useful in defining different stages or styles of gold mineralization.

4) Relatively unaltered felsic volcaniclastic samples which lack fractures and veins but contain a few percent finely disseminated pyrrhotite consistently contain less than 200 ppb gold.

A complex history of gold deposition is suggested by the deformation of possibly quite early gold-bearing fractures, the presence of several generations of sulphide minerals, and the variability of Au/Ag ratios. Gold distribution may have been controlled, at least in part, by synvolcanic structures and processes.

GEOLOGY OF THE CONTWOYTO LAKE AREA, CENTRAL SLAVE PROVINCE; ARCHEAN TO PROTEROZOIC DEFORMATION AND PLUTONISM

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Regional (1:100 000 scale) geological mapping and geochronology of igneous rocks in the central Slave Province has defined two major Archean magmatic episodes and their relationship to four phases of deformation. Earliest magmatism (2670 - 2650 Ma) preserved in the Contwoyto Lake area includes (1) the mafic to intermediate volcanism of the Central Volcanic Belt, (2) hornblende gabbro, (3) porphyritic granodiorite (spatially associated with Cu-Mo mineralization), and (4) biotite tonalite. A second major magmatic episode (2615-2585 Ma) comprises (1) biotite-hornblende diorite and biotite tonalite, (2) leucotonalite and, finally, (3) biotite (±muscovite) granodiorite to syenogranite. At some time in the 35 Ma interval between major magmatic episodes, extensive turbiditic (Itchen and Contwoyto Fms) and minor volcaniclastic rocks were deposited. D_1 isoclinal folding and cleavage formation occurred after deposition of the sediments and before the second major magmatic episode. Isoclinal refolding, cleavage formation and faulting (D_2) and low-P/high-T regional contact metamorphism accompanied the second magmatic episode. NE-trending, cross folds (D_3) post-date the youngest Archean intrusions. Open, NW-trending regional cross folds (D_4) post-date D_2 but are otherwise not well constrained in time. Two gabbro plutons that cut Archean structures may be Early Proterozoic in age. The through-going Proterozoic fault system is characterized by both brittle and ductile (mylonitic) fault rocks.

THE MOREL SILLS OF WOPMAY OROGEN, NWT: AN EXTENSIVE CONTINENTAL GABBROIC EVENT

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The Morel sills are an extensive swarm of gabbro sheets intruded into the sedimentary units of the Coronation Supergroup in the early Proterozoic Wopmay orogen. The sills intrude both the allochthon and autochthon, and extend eastward from the Wopmay orogen, through the Rockinghorse outlier, well into the Kilohigok basin. The sills occupy a critical chronostratigraphic position since they were intruded immediately prior to the Calderian collisional orogeny (ca. 1,885 Ga). This is demonstrated by the fact that the sills intrude all sedimentary units of the Coronation Supergroup up to and including the orogenic flysch, but are in turn metamorphosed and transported by the thrust faults.

The Morel sills are found in the thrust-fold belt of Wopmay orogen, principally along a broad zone extending from the Standbrige Lake area southwards and slightly to the east of the Coppermine valley. The principal exposures within the autochthon are on the large peninsula in Takijuk Lake, in the Cowles Lake area, and at Rockinghorse Lake, where the sills are bedding-concordant sheets 150 to 200 m thick although the Takijuk sill may be over 500 m thick.

Outside of the thrust-fold belt, the sills are remarkably fresh and display glassy margins at both roof and floor. Typically, they are uninverted pigeonite-bearing gabbros although olivine may occur near the base. Evidence of incipient differentiation comes from the localized development of miarolitic cavities and minor granophyric gabbro near the roofs. A detailed compositional section of the 171 m thick Cowles Lake sill revealed decreasing abundances of MgO, Ni and Cr upwards with corresponding increase in total Fe upwards, demonstrating minor in situ differentiation.

All the chilled margins sampled are quartz and hypersthene normative gabbros with identical REE spectra that are characterized by considerable LREE enrichment and moderately negative Eu anomalies. The REE patterns suggest that the magmas underwent contamination by crustal material at depth followed by plagioclase and pyroxene fractionation.

The widespread distribution of the sills and their compositional homogeneity, demonstrate the importance of the Morel event prior to the closing of the Coronation sedimentary basin in the Wopmay orogen.

Despite their minor in situ fractionation, the sills are not layered bodies and, thus, are not good exploration targets for stratiform Cr deposits or platinum-group elements. Cooling of these high-level plutonic bodies focused hydrothermal activity in the host rocks above them to form minor chalco- pyrite- and malachite-bearing veins.

MAGMATIC OXIDATION: CAUSES, MANIFESTATIONS AND IMPLICATIONS FOR THE GOLD EXPLORATIONIST

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Fion M. Cameron
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Recent studies have shown that important Archean gold deposits, including those at Hemlo and Kirkland Lake, Ontario, and Kalgoorlie, Australia, were formed from oxidized hydrothermal fluids. At high temperature, the solubility of gold increases directly with increasing oxygen fugacity of fluids. Major Archean gold deposits invariably formed within or near major shear zones and are frequently associated with felsic plutons. A number of these plutons have been shown to be derived from relatively oxidized magma. There are two possibilities for a spatial correlation between oxidized felsic magma and oxidized gold-bearing fluids. In the first, the fluids were released at depth from the magma. Since the fluids were CO_2-rich and the solubility of CO_2 in magma is small and

is pressure-dependent, released CO_2-rich fluids would have been throughout the rise of the magma. The second possibility is that the oxidized fluids and oxidized magma are common products of a CO_2-rich, oxidized regime in the lower crust or mantle.

Magmas may be inherently oxidized (at source) or they may become oxidized during their evolution by loss of a reduced, fugative gas, such as H_2. It is important to know how the gold-associated magmas acquired their oxidized character. This is determined by interpreting compositional trends of minerals precipitated from the melt. For example, mafic silicates (pyroxene, amphibole, biotite) may show an enrichment trend in Mg over Fe from core to rim. This was caused by progressive oxidation of the melt, with Fe partitioned into magnetite as Fe^{2+} and Fe^{3+}, rather than into silicates as Fe^{2+}. Another indicator is ilmenite ($Fe^{2+}TiO_3$), which may show enrichment in Mn^{2+}, again because of a Fe^{2+} deficiency in the magma. Titanite requires oxidizing conditions for its crystallization. Thus early, euhedral titanite, which may be enclosed within other minerals, often indicates an inherently oxidized magma.

Plutons derived from relatively oxidized felsic magmas can be readily identified in the field by their high magnetic susceptibility and, sometimes, by hematitization. Oxidized plutons with the characteristically elongate shape derived from magma intrusion into a shear zone, may be prospective for gold.

GOLD STUDIES IN THE CHURCHILL STRUCTURAL PROVINCE: B-ZONE CULLATON LAKE, SHEAR LAKE AND FAT LAKE DEPOSITS

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Field and petrographic studies indicate two contrasting styles of gold mineralization in the District of Keewatin. In the "Fat Lake" area, mineralization is hosted by an Archean quartz diorite that intruded pillowed basaltic flows of the Kaminak greenstone belt. This meso-thermal type of mineralization is contained in deformed quartz veins related to steeply dipping Archean ductile shear zones. Another type of mesothermal mineralization, Cullaton Lake B-Zone, is hosted in a magnetite + pyrrhotite bearing iron formation of the Archean Henik Group. Two alteration assemblages are recognized within the mineralized iron formation: i) chlorite; and, ii) quartz ± iron carbonate veining. The localization of extensive chlorite replacement (chloritite rock) along iron formation-greywacke contacts is interpreted as alteration accompanying deformation, possibly due to flexural slip and not as true silicate facies (magnetite-chlorite rock) which is however present within the iron formation. Quartz ± iron carbonate veining flood the iron formation and are locally associated with zones of high pyrrhotite content. Zones of high pyrrhotite content are localized near fold noses and are for the most part contained within a grunerite isograd.

In the Shear Lake deposit, gold is contained in late, near-vertical, east-west-trending brittle faults and breccia zones that cut the folded Proterozoic Hurwitz orthoquartzite and penetrate the Archean Henik Group metagreywackes. Gold-bearing pyritic fractures, faults and breccias are vertically zoned: an upper kaolinite grades into a chlorite then into a lower biotite zone. The Shear Lake gold deposit is interpreted as being Proterozoic and epithermal. Hence both the Archean and Proterozoic volcano-sedimentary sequences need to be evaluated for gold mineralization in the District of Keewatin.

1988 GEOLOGICAL SURVEY OF CANADA CONTRIBUTION TO CANADA-NWT MINERAL DEVELOPMENT SUBSIDIARY AGREEMENT 1987-1991

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The second year of the four year Canada-NWT Mineral Development Agreement began in April 1988. The Geological Survey of Canada is carrying 18 geoscience projects costing $1.29 million distributed amongst subprograms of: Regional Geology (35%), Mineral Deposits (25%), Quaternary Geology and Geochemistry (21%), Exploration Geophysics (18%) and Administration (1%).

Six geological mapping projects at 1:50 000 scale and more detailed are underway in the Regional Geology subprogram (Slave: Contwoyto-Nose Lake map-area and the Cameron River map-area, north of 63°; Churchill: portions of the Tavani and Schultz Lake map-areas; Bear: Mystery Island Intrusive Suite and the border zone of the Muskox Intrusion). These areas were chosen on the basis of current and anticipated mineral exploration as well as being relatively poorly known.

The Mineral Deposits Subprogram focuses on gold metallogenic studies in areas of past and current exploration (Slave: Courageous Lake area, Beniah Lake, Beaulieu River greenstone belt, Turner Lake belt, Yellowknife belt, Hackett-Back River area and the Pistol Lake Belt; Churchill: western Kaminak belt (Cullaton B-zone and Shear Lake deposits) and eastern Kaminak belt ('Fat Lake' and Kaminak Lake areas). Studies on the petrology of mafic-ultramafic intrusions and the distribution of PGE-Ni-Cu are continuing: the Muskox Intrusion, the former nickel producer at Rankin Inlet and ultramafic rocks in the Piling Group, central Baffin Island. Strategic and rare metal studies were widely distributed across the Territories (Slave: T-Zone of the Thor Lake deposit and related rocks of the Blatchford Lake complex; Churchill: cumulate syenitic intrusions in the Enekatcha Lake area; Bear: Mazenod Lake area; Northern Cordillera: South Nahanni River area; Arctic Islands: Nanisivik mine. Mapping and geochemical studies were supported to better define the ore-forming processes in the Polaris and Pine Point deposits. Stratigraphic mapping for clay diagenesis studies was begun on the Thelon siliciclastic sediments and underlying basement along the southeastern margin of the Thelon Basin in order to better evaluate the uranium potential of this part of the basin.

Under the Quaternary geology and Geochemistry Subprogram, reconnaissance and detailed till sampling programs in conjunction with glacial sediment distribution and ice flow history studies were initiated in areas of current gold and PGE exploration (Slave: Contwoyto Lake area; Churchill: Ferguson-Yathkyed Lakes and Turquetil-Maguse Lakes regions.

Two airborne surveys were flown under the Exploration Geophysics Subprogram: i) an aeromagnetic gradiometer survey in the Whitehills Lake area, north of

Baker Lake and ii) an integrated airborne geophysical survey (gamma ray spectrometer, magnetometer, VLF) centred in the area of Lupin and the Thor Lake deposits.

DETAILED MAPPING IN THE INDIN LAKE AREA: FIRST SEASON'S RESULTS

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There are two major metavolcanic rock units trending north to north-northeast through NTS 86B/6 (see GSC Map 1023A). Mapping in 1988 has confirmed that each of the units straddles the hinge surface of an anticlinal structure. The axial surface in the more easterly of the two units approximately coincides with that unit's western margin; the anticline in the western unit follows the eastern margin of that unit. Top reversals are more closely and irregularly spaced in the metasediments that surround each of the volcanic units than in the volcanics, hence the overall fold geometry is more difficult to decipher.

The sedimentary and volcanic rocks interfinger at scales ranging from individual beds to the major units. The contacts between some of the units are faulted.

In central 86B/6, two sets of syn- to late-metamorphic faults have been identified: relatively early, variably striking, steeply dipping faults (Set 1) which follow lithologic contacts and later north-northeast striking vertical faults (Set 2). The two sets are difficult to distinguish where lithologic contacts strike north-northeast. Down-dip stretching lineations are present in both fault sets, indicating steep (Set 1) or vertical (Set 2) slip vectors.

Two types of gold deposits have been examined. The first type consists of networks of quartz veins in relatively brittle rock bodies. Examples are the Colomac Dyke (an intrusive sheet of intermediate composition in mafic volcanics and intrusives) and the Gamble Dyke (a rhyolite body in turbidites).

Deposits of the second type are in quartz-carbonate vein systems associated with faults. The Kim, Cass, Diversified and North Inca deposits are all in or near prominent shear zones. Kim and Cass are in or near Set I shear zones in the southwest part of the western volcanic unit. Diversified and North Inca are at the contact of a smaller volcanic unit and are associated with a family of interbraided Set 2 shear zones (Leta Fault) that extends from Leta Arm southward through islands in Indin Lake.

U-Pb ZIRCON AGES FOR FELSIC VOLCANISM IN SLAVE PROVINCE

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U-Pb zircon dating of felsic volcanic rocks from widely separated sites in the eastern, central and northern Slave Province, together with previously published age data, have shown that volcanism occurred in two main episodes, at 2698-2687 Ma and at 2671-2663 Ma. Preliminary data for a sample from Point Lake suggest that supracrustal rocks greater than 2827 Ma in age may be present in this area. Two ages for units interpreted as possible volcanics, in the Izok Lake and Concession Lake areas, are 60 Ma younger than the end of major volcanic activity. If these units are extrusive, they would indicate that deposition of the Yellowknife Supergroup strata lasted considerably longer than previously thought. However, an alternative hypothesis, that the units represent relatively late, high-level intrusions, is equally possible given the available data. U-Pb dating of felsic metavolcanic rocks from other Slave Province greenstone belts, including those in the Hope Bay, Russell Lake, Indin Lake, Likely Lake, Upper Ross Lake, High Lake and Clan Lake areas is now in progress.

The main intention of this study is to date all of the major volcanic centres in the Slave Province and provide an absolute age framework for stratigraphic correlation and tectonic modelling. Thin felsic tuff layers within Burwash Formation turbidites have also been sampled in three localities. U-Pb ages for these tuffs will provide depositional ages for the host sediments and permit correlation between episodes of basinal sedimentation and volcanism in adjacent greenstone belts. This part of the study will be complimented by ages of detrital zircons from the turbidite units and from quartzites apparently deposited on "basement" complexes.

PRELIMINARY GEOLOGY OF THE HURWITZ GROUP

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Early Proterozoic supracrustal rocks of the Hurwitz Group crop out in a series of northeast-trending basins in the central portion of the Western Churchill Structural Province, from approximately 103°W, 59°N to 91°W, 63°N. The stratigraphy of the group has been well documented by previous workers. A thick orthoquartzite package overlies a basal conglomerate or is unconformable on the Archean basement. The upper portions of the succession contain intercalated pelites, carbonate, arkose, and mafic volcanics and gabbroic sills. Primary sedimentary structures are well preserved throughout the entire sequence, and metamorphic overprint is weak. It is therefore possible to do an integrated sedimentologic, structural, and tectonic analysis of the Hurwitz assemblage. Understanding the depositional history and subsequent Hudsonian (late Early Proterozoic) deformation of the succession in the context of the evolution of the Western Churchill Province will contribute to extant models for the region. Evaluation of the mineral potential of the various units in the Hurwitz Group will be aided by a detailed knowledge of the geology of the Hurwitz supracrustal succession.

Geologic investigations commenced in the summer, 1988. Mapping, section measuring, and sampling for geochronology and mineral assays was done in four areas to provide a reconnaissance look at the Hurwitz Group both along and across strike, in order to determine areas suitable for more detailed studies.

The southwest end of the Whiterock Belt, eastern District of Keewatin, has been subjected to two phases of deformation. Northeast trending folds define the form of the belt. Localized second phase folds trend 180-190°.

Preservation of sedimentary structures is excellent. Dominant primary features in the orthoquartzite are spectacularly rippled-marked bedding planes, bedding-parallel stratification defined by heavy mineral segregations, and low-angle tangential cross-stratification. Within the upper clastic units, sets of tangential cross-stratification and graded bedding are common. Gabbros intrude the upper stratigraphic units of the sequence, and many outcrops show sulphide mineralization. Samples from four outcrops of gabbro and two samples from the base of the orthoquartzite have been submitted for assay.

Preservation of primary structures at the northeast end of the Kaminak-Quartzite Belt, west of the Whiterock belt, is less consistent than in the Whiterock Belt due to stronger deformational overprint. Along the northwest margin, basement overthrusts the Hurwitz supracrustal sequence, verging southeast, and tight folds in Hurwitz Group rocks are overturned to the southeast. Folds become open and upright away from the tectonized northwest margin of the belt, and plunge gently northeast or southwest. A previously undocumented mafic volcanic tuff horizon occurs near the base of the orthoquartzite along the northwest margin. Where structural overprint is weak, the suite of sedimentary structures in the ortho-quartzite (ripple marks, bedding-parallel stratification, low-angle tangential cross-stratification) is strikingly similar to that in the Whiterock Belt. Mafic volcanic rocks are volumetrically the most significant lithology of the upper portions of the Hurwitz sequence in this area. Hurwitz gabbro from this area has been submitted for mineral assay. Schists at the contact with basement have sulphide mineralization, and a sample has been submitted for assay.

R.V. Beavon mapped a mafic volcanic unit (Spi Lake Basalt) and associated polymict conglomerates unconformably overlying Archean basement in the Carr Lake area, and suggested that the conglomerates were an extension of the basal Hurwitz Group rocks of the Kaminak-Quartzite Belt. Work done in the 1988 field season indicates that the Spi Lake Basalt and conglomerate is a rift sequence unconformable upon the Archean basement. The Spi Lake greenstones are intercalated with fluvially deposited arkosic and lithic arenites, overlain by debris flow conglomerates containing mafic bomb fragments. The Spi Lake conglomerates, however, are not the same as the Hurwitz conglomerates. The Spi Lake succession is separated from the Kaminak-Quartzite Belt of Hurwitz Group by outcrops of Archean basement, and the Hurwitz conglomerates contain abundant jasper clasts not found in the Spi Lake conglomerate, suggesting different provenance for the two units. It is tempting to model the Spi Lake sequence as a rift deposit pre-dating the widespread dominantly marine orthoquartzite deposits of the Hurwitz Group, but at this time the linkage between the two is unknown.

Both the Spi Lake and Hurwitz conglomerates are unconformable upon the gold bearing Kaminak Group volcanic rocks, and thus have the potential to contain placer gold deposits. Samples of both conglomerates have been submitted for assay.

In the Padlei Belt occurrence of primary structures is patchy due to the structural overprint. However, where preserved, the same suite of primary features are present as in the Kaminak-Quartzite and Whiterock belts. Gabbros were sampled for geochronology, and have been crushed at the geochronology lab of the Royal Ontario Museum. Badellyite cores with zircon overgrowths have been identified.

Based upon this reconnaissance work, it is possible to make some preliminary comparisons of the Hurwitz Group with the Early Proterozoic Amer Group. Both sequences unconformably overlie an Archean basement. Thick, areally extensive orthoquartzite dominates the lower portions of both sequences, but intense deformation in the Amer Group precludes comparative sedimentology of the two quartzites. In the Amer Belt, carbonate overlies the basal quartzites and is a thick (100-150 m) and widespread unit. Carbonate occurs only sporadically, and at variegated stratigraphic levels, in the observed portions of the Hurwitz Group. In the Amer Group, mafic volcanic rocks are restricted to the core of a narrow syncline along the southeast margin of the Amer Belt, and there is a small mafic intrusion at the southwest end of the Amer Belt, as documented by others. Conversely, the Hurwitz Group is intruded by gabbro sills both along and across strike and at the northeast end of the Kaminak-Quartzite Belt, mafic volcanic rocks comprise volumetrically approximately half of the Hurwitz supracrustal rocks. While there are some similarities between the Amer Group and Hurwitz Group, there are obviously significant variations in tectonic evolution of these two groups.

STRUCTURE AND REVISED STRATIGRAPHY OF THE NORTHERN KAMINAK/ENNADAI BELT, SOUTHWEST OF RANKIN INLET, DISTRICT OF KEEWATIN

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The Late Archean of the Kaminak / Ennadai Belt, 30 km southwest of Rankin Inlet, contains identifiable phases of extensional and compressional tectonism, operating at different times. The formations: the Last Lake Formation, consisting of mafic and felsic volcanics and breccias, polymictic conglomerates, greywacke, quartz arenites, and minor carbonate; and the Mistake Bay Formation, dominated by greywacke and banded ironstone. The latter formation may be younger. This sequence is intruded by a number of syn-post tectonic granitoids. The (?) Lower Proterozoic Hurwitz Group, comprising the Whiterock Member of the Kinga Formation and the Tavani Formation, consists of a sequence of ortho-quartzites and quartz arenite unconformably overlying both the Kaminak Group and the granitoids.

Archean conglomerates and turbidites contain features indicative of deposition in an extensional terrain. Subsequently two phases of Archean deformation, the first with horizontal detachments, developed in the supracrustal sequence.

D_1 is characterized by i) bedding parallel high strain zones with the development of phyllonites, mylonites, and ultra-mylonites; and ii) tight, recumbent (but not isoclinal) folds and steeply dipping shear zones; both generally trending northeast/southwest. This northeast trend dominates the area. These shear zones show a complex movement history, with early vertical movement and later horizontal movement.

Deposition of the overlying (?) Lower Proterozoic Hurwitz Group sediments is controlled by syn-sedimentary northwest/ southeast and eastwest faulting. D_2 constitutes the northwest trending folds and fabrics which developed in the Hurwitz Group sediments, and related shear zones in the Kaminak basement.

A large section of the area is virtually unmetamorphosed. This is well illustrated in a number of areas where bedding is vertical, no cleavage is developed, and sedimentary features are extremely well preserved. Greenschist facies metamorphism is only observed in the area of D_1 folding (west of Gill Lake).

Sulphide-bearing gabbros are contemporaneous with the mafic volcanites of the Kaminak Group. Sulphide and (? auriferous) quartz-carbonate vein assemblages post-date D_2, relate to particular phases of vein development rather that particular vein sets.

The tectonic framework of D_1 is at present unknown. Both extension and compression during D_2 and subsequently appear to occur within a framework of a long lived northwest/ southwest shear zone. Movement in this shear zone has been both dip-slip and strike-slip with sinistral shear.

STRUCTURAL STUDIES IN THE CONTWOYTO LAKE AREA; IMPLICATIONS FOR GOLD EXPLORATION

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Detailed (1:50,000 scale) mapping in the Contwoyto Lake area has resulted in the delineation of several volcaniclastic units in the dominantly turbiditic Contwoyto Fm, further resolution of the structural geometry of superposed deformations, and a chronological classification of quartz veins in the area. Several discontinuous units of dominantly intermediate volcaniclastic rocks (Shallow Bay volcanics) comprise thin- to thick-bedded, fine-grained to conglomeratic, epiclastic sediments, and possibly some flows. These rocks are interpreted to be interbedded with the Contwoyto Fm, confirming that volcanism was contemporaneous with turbidite deposition. In the area, the Contwoyto Fm is involved in at least three sets of Archean structures. D_1 and D_2 are characterized by tight to isoclinal folds, faulting and associated cleavage. Superposition of F_1 and F_2 results in fold interference patterns between Ramsay Types 2 and 3. D_3 is characterized by northeast-trending crenulation cleavage and open cross folds. Syn-D_2 metamorphic mineral assemblages represent low-P/high-T metamorphism. Five generations of quartz veins are distinguished on the basis of their interpreted chronology of emplacement. The volumetrically most abundant veins, formed during peak thermal conditions, include the 'late' quartz veins (with associated arsenopyrite and gold) that crosscut the Lupin ore unit.

A PRELIMINARY REPORT ON THE STRATIGRAPHY AND STRUCTURE OF THE METASEDIMENTARY-METAVOLCANIC SEQUENCE AT BENIAH LAKE, SLAVE STRUCTURAL PROVINCE, NWT

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A metasedimentary-metavolcanic sequence outcrops marginal to quartz-feldspathic gneiss (basement?) at Beniah Lake. Basal to the metasediments, and apparently unconformably overlying the gneiss, is the 700-1000 m Beniah Formation, which grades upward from quartz pebble conglomerate through quartz arenite into siltstone and mudstone. This formation includes minor rhyolite, volcaniclastic conglomerate, and calc-silicate rocks. Magnetite-chert iron formation and ultramafic rocks associated with the Beniah Formation may separate it from an overlying 2 km section of mafic volcanics.

The sedimentary and volcanic rocks have deformed and metamorphosed to greenschist and locally amphibolite facies. The supracrustal rocks form a major upright southwest-facing syncline. The earliest recognized fabrics are steep bedding-parallel flattening foliation and down-dip elongation and mineral lineation. The fabrics are intensified in discrete high strain zones parallel to bedding. Later crenulation and minor upright folds trend north. Ductile strike-slip shear zones, north sinistral along a straight zone on the western shore of Beniah Lake, and northeast dextral along the major syncline, may have formed by antithetic shear in response to east-west shortening during crenulation cleavage development. Ubiquitous north mafic dykes cross-cutting all supracrustal rocks are metamorphosed and foliated north. Later granites include tabular bodies that separate the supracrustal rocks from the basement(?) gneiss.

ARCHEAN QUARTZ ARENITES AND PYRITIC PALEOPLACERS IN THE BEAULIEU RIVER SUPRACRUSTAL BELT, SLAVE STRUCTURAL PROVINCE

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Quartz arenite recently recognized at Beniah Lake, 140 km northeast of Yellowknife, has been found to be part of a much more extensive formation deposited at the base of the northern part of the Beaulieu River supracrustal belt. Another clastic sedimentary unit, subdivisible into conglomerate and quartz arenite members, has been found as a synclinal remnant unconformably overlying volcanic rocks. Folds and cleavage in these strata reflect a complex history of deformational events in the belt. Slightly uraniferous, slightly auriferous, pyritic quartz pebble beds are present in both formations. These reveal the existence in the Slave structural province of a previously unrecognized exploration target - pyritic gold paleoplacers.

STRUCTURE AND LITHOLOGIC CONTROLS OF GOLD BEARING QUARTZ-BRECCIA BODIES IN METATURBIDITES GORDON LAKE

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Introduction

Within the Archean Slave Province gold exploration has concentrated on the volcanic belts, volcanic-metaturbidite contacts, and iron formation bearing units. In terms of area, these environments account for less than 50% of Slave supracrustal rocks. However, a better understanding of the geological controls of mineralization within the vast remaining metaturbidite terranes, could facilitate area selection and targeting, thus leading to new economic discoveries. Typically, metaturbidite hosted gold quartz veins are single or multi-vein systems with high, though erratic grades (20-350 g/t) and small tonnages (25-40,000 t), with the exception of the (120,000 t) Thompson-Lundmark mine (Padgham, 1986). However, gold bearing quartz-breccia zones, such as the Kidney Pond Zone 1 (near the southern end of Gordon Lake), represent relatively large (about 100,000 t) deposits of a more even grade, with the added advantage of predictable satellite zones in the immediate vicinity. The purpose of this study is to develop a genetic model with predictive capability that will assist in the exploration for, and the evaluation of gold bearing quartz-breccia zones within the metaturbidite terranes of the Slave Province.

Structural mapping around the Kidney Pond deposit and the southern end of Gordon Lake (62°54'N; 113°15'W, 70 km north-northeast of Yellowknife) during the summers of 1986-88, examination of underground workings and drill core of Giant Bay Resources Ltd., (1984-87) and subsequent laboratory work, have led to a working hypothesis that is consistent with observations. The Kidney Pond gold (±arsenopyrite, pyrrhotite, pyrite) bearing quartz-breccias probably formed by focusing of metamorphic type hydrothermal fluids through the axial planar region of a (kilometre scale) fold. The quartz breccias are controlled by structural and lithologic parameters recognizable in the field. Analytical and fluid inclusion work is underway to test the genetic model and evaluate its applicability to the Slave metaturbidite terranes and elsewhere.

Gordon Lake structure, lithology

Within greenschist-grade metaturbidites of the Burwash Formation of the Yellowknife Supergroup, regional and detailed mapping has identified structural features resulting from at least three deformational events (D_1[1], D_3 and D_4), and seven morphological types of quartz veins. Vertically plunging isoclinal folds (F_1) are folded in part by a D_3, forming a large (kilometre scale) refold (Figure 1). D_3 is probably associated with peak greenschist metamorphic conditions, and appears as a pervasive S_3 regional cleavage (which in part transects the refold), and as a vertical stretch lineation (L_3). The strain field on the west limb of the refold is dominated by vertical extension, whereas on the east limb this strain is characterized by an additional horizontal extension related to a younger (D_4) deformation, as is evident by stretched and boudinaged

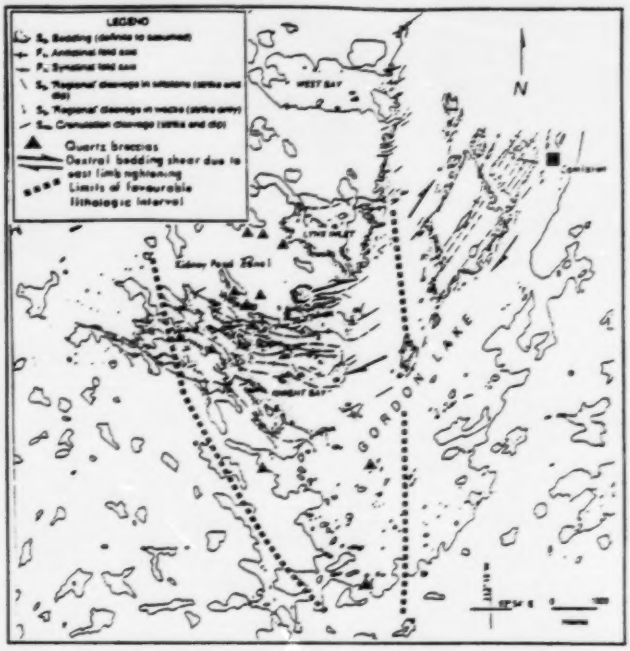

FIGURE 1: STRUCTURAL GEOLOGY OF THE GORDON LAKE 'REFOLD' HINGE

veins D_1 accounts for the asymmetrical shape of the Gordon Lake refold, the presence of discrete crenulation (S_{4a}) of the S_3 cleavage in the refold's central domain, and a possible extension-type crenulation of S_3 on the east limb domain.

Quartz veining spans the whole deformational history of the metaturbidites, but not all veins are auriferous. The morphological types include: 1) bedding-parallel veins, 2) wacke-hosted (D_4) deformed veins, 3) sub-horizontal veins, 4) S_3-parallel veins, 5) S_{4a}-parallel veins, 6) stretched veins (east limb domain), and the 7) quartz-breccias. The quartz-breccias are found as three structural types: 7a) are associated with axial traces of F_1 folds, 7b) black siltstone-hosted strata-bound breccias on the limbs of F_1 folds, and 7c) breccias related to F_3 flexes. Gold is associated predominantly with vein types 3 to 7, which were formed during and towards the end of metamorphism, and in particular in 7b quartz breccias, which characterize the Kidney Pond. The mineralogical distribution and character of the gold is still under study. Gold is more commonly associated with a dark gray variety of quartz, the colour is probably the result of to carbon impurities.

The Kidney Pond quartz-breccia Zone 1 has poor surface exposure but diamond drilling and over 400 m of underground development shows that the Zone lies on the north limb of a west-northwest trending F_1 anticline and is confined to a package of black siltstones. (Locally, however, the breccia does cross from one siltstone bed or package to another). At least two distinct mesoscopic types of breccia are recognised: 1) a fine micro-breccia of equidimensional siltstone fragments that is associated with white quartz/feldspar and a coarse biotite matrix and 2) a (paragenetically younger) breccia with elongate siltstone fragments broken along the S_3 cleavage, in a matrix of gray quartz (which accounts for 85% by volume of the matrix material). Some zones of breccia and sulphide mineralization, which include arsenopyrite (of two types, a

[1] Structural nomenclature is based on Fyson (1982). Note Fyson's D_2 has not been recognized in this area.

disseminated D_3 strained type and unstrained veinlets), pyrite and pyrrhotite, are sheared or crenulated by the S_{4a} cleavage. Pink potassium feldspar and carbonate material infill late fracturing of the breccia.

A distinct lithological contrast is recognised across Gordon Lake. A southward tapering wedge-shaped area underlain by siltstone occurs along the axis of Gordon Lake and is surrounded (at least to the east, west and south) by coarse and fine grained wackes. The gold-bearing quartz breccia zones lie along the western transitional margin where siltstone/wacke ratios are 1 or greater. The transition is characterised by sequences of finely laminated siltstones and gray to black (carbonaceous and sulphide rich) siltstones interbedded with wackes. Tracing of wacke/siltstone packages in this transition indicates warping of the wacke units around the folded and repeated siltstone units, which are comparatively strongly folded and repeated. Commonly the siltstone dominated areas (such as Gordon Lake) have been more deeply eroded and are, therefore, poorly exposed.

Genetic Model

As indicated above, the larger and richest breccia bodies are both structurally and lithologically controlled: 1) they appear restricted to crenulated regions along the axial trace of the regional refold and 2) they are hosted within a particular lithologic interval rich in black carbonaceous siltstones. The crenulated region is the result of dextral bedding-parallel slip during the asymmetrical tightening of the refold accompanied by hinge migration. The black siltstone package is variable in its siltstone/wacke ratio and, therefore, controls the proportion of bedding-parallel slip deformation.

It is suggested that the Kidney Pond type breccias formed during the late stages of D_3 and at the initial stages of S_{4a} development. Over-pressuring of late metamorphic fluids and the dextral D_4 bedding parallel slip created fracture openings (dominantly parallel to S_3) in the siltstones and resulted in stratabound arrays of echelon veins. Continued D_4 bedding caused overlapping of echelon veins, vein back-rotation and subsequent brecciation. The brecciation was enhanced by the particular chemical and physical properties of the black carbonaceous siltstones, which increased the fluid pressure in two ways: (a) by devolatilization reactions during hydrocarbon maturation/generation and prograde metamorphism, and (b) by mechanical incompressibility during strain of the relatively impermeable shaly rocks.

We suggest that hydrothermal fluids were derived from a metamorphically dewatering and devolatilizing turbidite pile. The gold was probably scavenged from altered volcanic detritus which constitutes the bulk of the wacke-siltstone matrix and a considerable proportion of the clasts. Volcanic rocks may have been the source of the gold in volcanic hosted shear-related deposits of Yellowknife (Kerrich and Fyfe, 1988); their clastic derivatives are equally good candidates as sources of vein constituents, such as gold, arsenic and silica. The metamorphic fluids were focused through permeable zones developed by preferential hydraulic fracturing of carbonaceous siltstones. Earlier formed physical inhomogeneities, such as folds, foliations and quartz veins locally assisted the brecciation process. The age of the main mineralizing event is probably coincident with (or slightly post) the peak metamorphism. Gold was probably transported as reduced sulphur (and arsenic) complexes in a fluid rich in methane and carbon dioxide. Precipitation of quartz and gold was probably triggered by sudden decompression associated with hydraulic fracturing, which decreased the solubility of silica and the stability of gold-carrying complexes. The organic matter within the rock formations exerted both physical and chemical influences: 1) it may have enhanced fluid overpressures, thus performing a role in rock failure, and 2) it preserved sulphides from oxidation, determined the low oxygen fugacity of the metamorphic fluids, and thus assisted in the transport and precipitation of gold.

Fluid inclusion, mineralogical, geochemical and isotopic studies of host rocks, alteration and vein assemblages are underway to document and test the above model. An attempt is being made to date micas in metamorphic, mineralized quartz breccia and plutonic rocks of the Gordon Lake region by the $^{40}Ar/^{39}Ar$ method in order to refine timing constraints.

Conclusions

1. Kidney Pond type gold-bearing quartz breccia bodies formed pre-ferentially in zones of cleavage crenulation in the axial domain of a kilometre-scale refold.
2. The breccia bodies formed preferentially in beds with a siltstone/wacke ratio close to unity. This favourable lithology defines a mappable unit.
3. The most significant breccia bodies formed within black, carbonaceous, sulphide-rich siltstones.
4. Higher gold values are found in dark grey quartz.
5. The preferred genetic model for Kidney Pond type gold-bearing breccia bodies involves focusing of metamorphic fluids through channelways which formed within hydraulically fractured siltstones. Organic matter within the formations has exerted both physical and chemical controls.

References

Fyson, W.K., 1982, Complex evolution of folds and cleavages in Archean rocks, Yellowknife, NWT; Canadian Journal of Earth Sciences, Volume 19, pp. 878-893.

Padgham, W.A. 1986. Turbidite-hosted gold-quartz veins in the Slave Structural Province, NWT; in Turbidite hosted gold deposits. D.J. Keppie, R.W. Boyle, and S.J. Haynes (editors). Geological Association of Canada. Special Paper 32, p 119-134.

Kerrich, R. and Fyfe, W.S. 1988. The formation of gold deposits with particular reference to Archean Greenstone Belts and Yellowknife (Parts I and II). Contributions to the Geology of the Northwest Territories, Volume 3, 1988, NWT Geology Division, INAC, Yellowknife. ed. W.A. Padgham.

FAULT-BOUNDED DOMAINS WITHIN THE BEAULIEU RIVER VOLCANIC BELT, NWT: A PRELIMINARY REPORT

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Previous mapping of the northern portions of the Beaulieu River volcanic belt (Miller et al., 1951), Slave Province, NWT, indicated an irregular and branching outline to the roughly northerly trending supracrustal belt. Preliminary investigation suggests much of this irregularity can be attributed to late-stage faulting.

In the Spencer Lake area (NTS 85 P/1,2), several fault-bounded "domains" within the volcanic and adjacent gneissic/granitic rocks have been delineated. Domain boundaries coincide with mapped fault or shear zones, or with strong photo lineaments, and separate blocks with distinct differences in a combination of the following: a) lithology/stratigraphy, b) fold style and orientation, c) strain history, d) younging directions and, less commonly, e) metamorphic grade and f) economic mineralisation. The post-foliation boundary faults have typically northwest, northeast or north trends. The sense of major movement on the youngest north-trending set is sinistral and subhorizontal.

A rhomb-shaped supracrustal domain in the southernmost portion of the map area is characterised by a thick sequence of pillowed volcanic rocks overlain unconformably by a quartz arenite and conglomerate unit. Although three phases of tight to locally open folding are recognised in the upper clastic sequence, foliation development and clast deformation are remarkably weak. Variations in pillow flattening and younging directions in the underlying volcanics also reflect a history of multiple folding.

Immediately north of the rhomb-shaped domain, the supracrustal exposures narrow abruptly into a zone of thin northerly-trending units. Intense shearing and pervasive vein development are common locally. Well-developed foliations can have remarkably consistent orientations within a single unit. Pillowed lavas young away from the centre of the zone and towards the bounding gneisses. This precludes interpretation of the supracrustal belt as a synclinal remnant between basement gneisses. The non-repetition of distinctive units across the zone also suggests a simple anticlinal structure is unlikely. It is proposed that this zone comprises numerous fault slivers juxtaposed at a late stage in the tectonic history.

Movement along faults oblique to lithological boundaries can tend to "smear out" individual units. Lack of stratigraphic continuity both across and along the resulting configuration would be expected. The Beaulieu River volcanic belt within NTS 85P appears to record this process. Mapping to the north may reveal segments of once-continuous units and permit a better understanding of the complex faulting history.

Reference
Miller, M.L., Barnes, F.Q. and Moore, J.G.C., 1951: Carp Lakes; Geological Survey of Canada, Preliminary map 51-8.

THE TURQUETIL GOLD DISCOVERY KEEWATIN DISTRICT

Ian S. Thompson, Mark Waychison
Derry, Michener, Booth & Wahl

Stanley D. Robinson
Dejour Mines Limited

The Turquetil gold discovery is situated in the Rankin Inlet-Ennadai greenstone belt, District of Keewatin, NWT, 225 km (140 mi.) southwest of Rankin Inlet. The property is held jointly by Dejour Mines Limited (T.S.E.) and by Noble Peak Resources Limited (A.S.E.). Dejour, assisted by its consultants, Derry, Michener, Booth & Wahl of Toronto, is the project operator and has conducted exploration there for the past two years.

First reported exploration in the area was by Giant Yellowknife Mines in the early 1960's on a gold showing near the east bank of the Turquetil River, just north of its entrance into Turquetil Lake. Regional mapping of the project area, carried out by the Geological Survey of Canada in the early 1970's, classified this and other gold showings in a lithological setting that is considered to be similar to the Larder Lake carbonate-hosted gold deposits.

In 1976 Essex Minerals Co. intersected 0.212 oz. Au/ton over 43 ft. (TAU 76-I) while undercutting the showing at Turquetil. In 1978, following up an IP survey, a hole collared 400 ft. grid west of TAU 76-1 intersected 0.14 oz. Au/ton over 9 ft. (TAU 78-3) and anomalous gold values were intersected in a hole collared 200 ft. grid east (TAU 78-1). Additional infill drilling was not carried out.

In 1987 Dejour and Noble Peak staked about 15,000 ha (37,464 acres) to explore for a Larder Lake-type carbonate-hosted gold deposit. A 522 ha claim (Joyce 1), covering the gold showing explored by Giant and Essex, was optioned for the joint venture. The property was enlarged to about 40,000 ha (100,000 acres) by staking in 1988.

Regional and detailed mapping, prospecting and detailed channel sampling were carried out by Dejour in 1987 and continued in 1988 with the assistance of airborne electro-magnetic and magnetic surveys. In 1988, 10,500 m (34,460 ft.) of diamond drilling in 64 holes was completed.

The supracrustal rocks within the project area consist of the Archean Kaminak Group, volcanics and sediments, intruded by Archean mafic to felsic plutonic rocks. These rocks lie within the Churchill Province. They have been structurally deformed by late Archean and Hudsonian tectonic events that produced lower to middle greenschist facies of probable Kenoran age metamorphism with a Hudsonian overprint.

The surface sampling concentrated on iron-carbonate alteration horizons hosted within mafic to intermediate flows and tuffs. These horizons have been traced from the Turquetil discovery showing to the southwest for 13 km (8 mi.); to the north and northwest for 10 km (6.2 mi.); and, to the southeast for about 12 km (7.5 mi.). These horizons are anomalous in gold at several localities.

The focus of the intense diamond drilling program was to determine the extent of gold mineralization cut in hole TAU 76-I. Continuous gold-arsenide-sulphide mineralization has now been intersected along a strike length of 940 m (3,083 ft.) from section 3+40 m E to 6+00 m W, and bisected by the Turquetil River. Gold has also been intersected in three holes drilled to test a second showing of similar quartz-veined carbonate-rich, mafic volcanics at Hook Lake. This lies 700 m (2,296 ft.) west of and on the geological trend of the continuous zone.

Drilling to date indicates that, east of the river, there are at least two gold-bearing, sheet-like zones. These trend northeast, dip steeply northwest and contain higher grade gold shoots that plunge steeply north-northeast. The two zones may be a reflection of folding or faulting. West of the river only one gold zone has been intersected. It is predominantly on the north or hanging wall side of a northeast trending fault that dips north and has been traced for 1,200 m (3,900 ft.). There are other subsidiary faults.

Faults occur as: (i) gouge-filled zones, sometimes sulphide bearing; and (ii) annealed cataclastic zones with brecciated, quartz-ankerite stockwork veins.

Within this alteration system, gold and arsenopyrite (pyrite) content increases towards the faults. The relationship of the faults to the mineralization is not known, but it is assumed to be either syn- or post-mineralization. In addition, several other north-south trending transverse faults are present and vertical displacement is inferred. These faults most probably post-date the mineralization.

Gold occurs with abundant arsenopyrite and pyrite within a horizon of intense iron-carbonate alteration. The alteration consists of extensive ferroan carbonatization of primarily steep southeasterly-dipping, mafic volcanics over widths of up to 100 m (328 ft.) or more and is characterized by a magnetic low associated with an induced polarization (pole-dipole array) anomaly. The zone typically shows a progressive replacement inwards of calcite to ankerite, locally accompanied by talc and minor sericite and progressive alteration of ilmenite to leucoxene pseudomorphs. The alteration horizon appears to be stratabound, steeply north dipping, folded, boudinaged and locally intensely foliated, and is believed to predate tectonism.

The highest gold values coincide with strongly carbonatized zones that exhibit semi-massive, arsenopyrite veins, 1.0 to 3.0 cm wide, with lesser values in zones of disseminated sulphides. Both disseminated pyrite and arsenopyrite commonly show pressure shadows and are aligned along S_2 foliation. This implies that arsenide and sulphide mineralization is either pre- or syn-kinematic.

A banded pyrite cherty horizon, apparently an exhalite horizon that appears infrequently in drill core with the alteration horizon, does not show any significant arsenopyrite or gold.

The most encouraging results to date include 0.126 oz. Au/ton over 125.4 ft.; 0.173 oz. Au/ton over 43.4 ft. including a section of 0.288 oz. Au/ton over 18.l ft. and 0.269 oz Au/ton over 27.9 ft. at a vertical depth of 650 ft. The gold-bearing zone is consistent in appearance where drilled and is open along strike and to depth.

Additional assays include:

width (feet)	grade (oz/T)
12.8	0.374
9.8	0.290
9.8	0.265
9.8	0.227
6.9	0.227

CONTINUING DEVELOPMENT OF THE THOR LAKE RARE-METAL DEPOSITS

D.L. Trueman, Chris Pedersen
Highwood Resources Ltd.
Vancouver

Since the mining and bulk sampling operation at Thor Lake in 1985-86, steady progress has been made toward the exploitation of the beryllium deposits.

This work included in 1986, the pilot-plant scale production at Lakefield Research of phenacite concentrates and led to delivery in 1987 of conceptual blueprints for the circuitry and concentrator facility at Thor Lake. During 1987 further research was conducted by Hazen Research in Colorado, leading to the bench-scale production of beryllium hydroxide from the phenacite concentrates.

This past year has been spent refining the concentrator design for purposes of improved efficiency and reduction of capital costs. Modifications, to this end, were tested during the spring of 1988. In October delivery was taken at Lakefield Research of a convertor used to digest the phenacite concentrates to produce $Be(OH)_2$ on a pilot-plant scale.

While data have been being collected for engineering purposes other activities have included marketing and environmental programs and a site-selections study for a chemical plant location. All of this work will lead to production feasibility decisions in early 1989.

MINING RESEARCH AT THE MINING RESEARCH LABS OF CANMET THROUGH FEDERAL/PROVINCIAL (AND TERRITORIAL) MINERAL AGREEMENTS

John E. Udd
Mining Research Laboratories
Canmet, EMR, Ottawa

During the past three years, applied mining research projects have been initiated in several provinces, principally through Federal / Provincial Mineral Development Agreements. Work is now in progress in Manitoba, Ontario, New Brunswick, the Northwest Territories and Saskatchewan. Additional projects are being developed for implementation in the Yukon and Northwest Territories and several of the provinces.

All of the projects have been started after consultations with industry and/or provincial mining associations and address stated industry needs. The results will, therefore, be directly relevant to the industry. Additional benefits to CANMET/MRL are that a much greater proportion of research is being done externally and that communications with the industry have improved.

The author will review projects that have commenced.

THE GEOLOGY OF THE SUNRISE Ag-Zn-Pb MASSIVE SULPHIDE DEPOSIT, BEAULIEU RIVER VOLCANIC BELT

Gary Vivian, Lou Covello, Doug Bryan
Aber Resources Ltd./Hemisphere
Development Corp.

The Sunrise Deposit is an Archean polymetallic Zn-Ag-Pb-Au banded massive sulphide lens (lenses).

The Sunrise Deposit is in a sequence of intermediate to felsic volcanics. In particular, this banded massive sulphide is hosted by a rhyolitic tuff which has been slightly brecciated. This lens is conformable with the stratigraphy, dips at 60-65° to the east, and plunges steeply (60°) to the north.

The major mineral phases of the ore suite are pyrite, sphalerite, galena, tetrahedrite, arsenopyrite, pyrrhotite and minor chalcopyrite. Other minerals include pyrargyrite, boulangerite, native silver, native gold, gudmundite and stannite.

The current outline of the ore zone suggests a 160 m strike length, an average thickness of 3 to 3.5 m and a down-dip projection of approximately 700 m. The ore zone appears to have been deformed by a prominent block fault, indicative of a caldera-type setting. Individual elements contoured on a longitudinal section outline the primary lens and the possibility of other lenses occurring.

The most recent grade and tonnage calculations suggest: probable tonnage of 1,281,000 tons grading 10.4 oz/ton Ag, 0.029 oz/ton Au, 4.05% Pb, 8.35% Zn and 0.09% Cu; and possible tonnage at 776,000 tons grading 14.1 oz./ton Ag, 0.027 oz/ton Au, 4.51% Pb, 9.76% Zn and 0.11% Cu.

These figures suggest that Sunrise is an average-sized deposit but is remarkably high-grade compared to most massive sulphide deposit hosted in intermediate to felic volcanics.

GEOCHEMISTRY OF THE ORE-RELATED METASOMATIC ALTERATION PERIPHERAL TO MINERALIZATION AT THE NERCO-CON MINE, YELLOWKNIFE, NWT

Dave R. Webb, University of Western Ontario, London

Major orebodies at the NERCO-Con Mine are hosted within the Campbell shear zone. The Campbell shear zone is a large curviplanar domain dominated by chlorite schist. These schists are silicified, carbonatized, sulphidized and sericitized to various degrees adjacent to auriferous quartz veins. Peripheral to this visible alteration is a cryptic metasomatic alteration that extends for up to hundreds of metres. Major oxide, trace element and isotopic analyses of several hundred visibly unaltered chlorite schist samples external to known orebodies have been collected. Extraneous geochemical trends introduced by variations in the protolith, and earlier alteration effects are reduced by multivariate data analysis, and the results are plotted with reference to known orebodies. Important inter-element relationships are interpreted from spatial relationships between the orebodies and the geochemical results. Increased TiO_2, Al_2O_3, Fe_2O_3, V, and Cu coupled with decreased CaO, K_2O, P_2O_5, S, Ni, Rb, Sr, and Ba abundances are interpreted to be related to a primary tholeiitic trend, whereas increased SiO_2, Al_2O_3, Na_2O, and Co abundance, with a concomitant decrease in Fe_2O_3, CaO, LOI, S. As, and Zn are thought to represent a primary calc-alkaline trend. A "gold-related" factor, is devised, and some interesting exploration targets within the NERCO-Con Mine are generated.

CONSTRAINTS ON THE NATURE OF THE FLUIDS IMPLICATED IN THE FORMATION OF THE SHEAR ZONE-HOSTED GOLD DEPOSITS AT YELLOWKNIFE, NWT

Dave R. Webb, University of Western Ontario, London
R.W. Kerrich, University of Saskatchewan, Saskatoon

Oxygen and carbon isotope data from carbonates extracted from rocks from the Campbell and Giant shear zones in Yellowknife reveal systematic variations in oxygen and carbon isotopic compositions. Average oxygen isotope values of 8.9, and 10.2 per mil ($\delta^{18}O$ relative to SMOW) are characteristic of the ankerite and calcite separates from the ubiquitous chlorite carbonate schists from the Campbell shear zone. $\delta^{18}O$ values range from +16 per mil to +7.1 per mil relative to SMOW. Carbon isotopes from these same carbonates range from $\delta^{13}C_{(PDB)}$ values of 0 to -6 per mil.

There appears to be a depth related control in the $\delta^{18}O$ of the carbonates. Calcite and ankerite from chlorite carbonate schists deeper than 1200 m below surface characteristically have $\delta^{18}O$ values less than +10 per mil, whereas those shallower than 1200 m generally are more enriched in ^{18}O and quartz $\delta^{18}O$ values are uniform to within 1 per mil from surface to 1615 m. A disequilibrium relationship in the $\delta^{18}O$ between coexisting quartz and carbonate pairs suggests that later surface waters shifted the carbonates to variably ^{18}O - enriched values. Carbon isotope systematics reveal a more complicated trend related to Eh and pH fluctuations within the mineralizing fluid system. The data suggests that pH fluctuations in the fluid near the pyrite-pyrrhotite stability fields caused most of the variation in the ^{13}C composition of the carbonates as well as the pyrite to pyrrhotite dominance in the orebodies within the Campbell shear zone. This would confirm the coeval textural relationship between the carbonates in the shear zones and the sulphides in the orebodies within the shear zones. The same event, and fluids are likely responsible for the deposition of gold within the shear zones at Yellowknife.

PEGMATITE DEPOSITS OF NWT: AYLMER LAKE-MACKAY LAKE AND CHANTREY INLET PEGMATITE FIELDS

Michael A. Wise
Dept. of Mineral Sciences,
Smithsonian Inst., Washington, D.C.
P. Cerny
University of Manitoba
Winnipeg, Manitoba

The Aylmer Lake-Mackay Lake region is the second major area within the Archean Slave Structural Province of Canada known to contain abundant pegmatite deposits. In comparison to the well-studied Yellowknife pegmatite field, the Aylmer Lake-MacKay Lake pegmatite field also consists of predominantly large, extensive granitic plutons surrounded by numerous pegmatites which intrude metasedimentary rocks of the Yellowknife Supergroup(?).

Preliminary investigation of this region involved the identification, examination and detailed sampling of 11 previously reported pegmatites and 55 new pegmatites. Four small regions within the field, distinguished primarily by the geographic distribution of pegmatites and to a lesser extent by mineralogical and geochemical differences, may be recognized; Reid Lake - Be, P; Kirk Lake - B, (P); Aylmer Lake -Be, (Nb, Ta), (Li?) and "Nebish Lake" - Be, Li (Nb, Ta). Regional zonation of pegmatites around granitic plutons appears to be poorly developed throughout the field.

The pegmatites of the Chantrey Inlet field lie within the Barclay and Chantrey greenstone belts of the northern Churchill Structural Province. Pegmatites of the Barclay belt vary from barren to beryl-columbite types whereas pegmatites of the Chantrey belt are barren. Within the Barclay belt, small stocks of pegmatitic leucogranite intrude gneissic rocks immediately east of the pegmatites, whereas granitic plutons are not observed associated with the pegmatites in the Chantry belt.

16th ANNUAL GEOSCIENCE FORUM
YELLOWKNIFE, DECEMBER 6 - 8, 1988
EXPLORER HOTEL

TUESDAY, DECEMBER 6, MORNING SESSION: - CHAIR: George Patterson
EMR, Gov't of the NWT

WELCOME by:

8:50 **The Honourable Nellie Cournoyea**, Minister of EMR, Government of NWT

Mr. P. J. Laporte, A/Director, Minerals & Economic Analysis, INAC, NAP

9:05	**Michael Cunningham** Pamorex Minerals Inc.	NWT Mineral Exploration Liaison Committee (MELC)
9:15	**Jamie Gebert** GNWT, Can-NWT/MDA	Preliminary mapping in the Hope Bay metavolcanic belt, northeastern Slave Province
9:35	**Rob Johnstone** GNWT, Can-NWT/MDA	Geology of the Torp Lake area, western Bathurst Inlet
9:55	**Janet King** Carolyn Relf W.J. Davis GSC, Can-NWT/MDA	Geology of the Contwoyto Lake area, central Slave Province: Archean to Proterozoic deformation and plutonism
10:15	**Carolyn Relf** Queens U. Can-NWT/MDA	Structural studies in the Contwoyto Lake area: implications for gold exploration
10:55	**Charlie Jefferson** C.J. Beaumont-Smith R.L. Lustwerk GSC, Can-NWT/MDA	Stratigraphic and structural settings of iron formations and gold in the Back River area, District of Mackenzie,
11:15	**Andy Abraham** Can-NWT/MDA U. of Toronto	Tonalite-hosted Au-quartz vein/shear zone mineralization, Arcadia Bay, Coronation Gulf
11:35	**Andre Lalonde** U. of Ottawa	Morel sills of the Wopmay orogen, an extensive continental gabbroic event

TUESDAY, DECEMBER 6, AFTERNOON SESSION - CHAIR: Mike Magrum

1:30	**John Morgan** GNWT, Can-NWT/MDA	Geological mapping, Indin Lake volcanics
1:50	**Mike Stubley** GNWT, Can-NWT/MDA	Fault-bounded domains within the Beaulieu River volcanic belt: a preliminary report

2:10	**Dan Roach** U. of Ottawa Can-NWT/MDA	A preliminary report on the stratigraphy and structure of the metasedimentary-metavolcanic sequence at Beniah Lake
2:30	**Stu Roscoe**, GSC Mike Stubley, GNWT Dan Roach U. of Ottawa Can-NWT/MDA	Archean quartz arenites and pyritic paleoplacers in the Beaulieu River supracrustal belt, Slave Province
3:10	**Al Miller** GSC	Geological Survey of Canada 1988; Canada-NWT MDA Program
3:30	**Ralph Bullis** Echo Bay Mines	Lupin Mine - an update
3:50	**Dave Webb** U. of Western Ont. Bob Kerrich U. of Sask.	Constraints on the nature of the fluids implicated in the formation of shear zone hosted quartz vein deposits at Yellowknife
4:10	**R. L. Comeau** Total Energold	The Tundra gold venture; an update
4:30	**Craig Ford** Colorado School of Mines	Metasomatic gold concentrations in Archean Iron Formation, Slave Prov.

WEDNESDAY, DECEMBER 7, MORNING SESSION - CHAIR: John Brophy

8:50	**Val Jackson** NWT Geol. Div.	Geology of the Slemon-Russell Lake Basin
9:10	**Jim Mortensen** GSC	U-Pb Zircon Ages for Felsic Volcanism in the Slave Province
9:30	**Hendrik Falck** J.A. Donaldson Carleton U, NWT Geol. Div.	New Ideas about Yellowknife Volcanic Belt Stratigraphy: Giant Section, Yellowknife
9:50	**Dave Webb** U of Western Ont.	Geochemistry of ore related metasomatism peripheral to mineralization at the NERCO-Con Mine
10:10	**Walter Gibbins** NWT Geol. Div.	The Myth of the Mackenzie Shale Basin and other misconceptions, Pine Point Lead-Zinc District
10:40	**John Udd** EMR - Canmet	Mining Research at the Mining Research Lab of Canmet under MDAs
11:00	**Derek Ford** McMaster U.	Karsting, caves and zinc deposits
11:20	**Don Dudek** Ark La Tex Ind./ Silver Hart Mines Ltd.	The Geology of the Bear Property, Sunrise Lake

11:40	**Hewitt Bostock** GSC	The significance of ultramafic, gabbroic and anorthositic remnants in some gneisses at the east margin of the Taltson Magmatic Zone

WEDNESDAY, DECEMBER 7, AFTERNOON SESSION - CHAIR: David Arthur

1:40	**Al Miller** GSC, Can-NWT/MDA	Gold studies in the Churchill Structural Province B-Zone Cullaton Lake deposit, Shear Lake deposit and the Fat Lake deposit, Kaminak Green- stone belt
2:00	**Gary Vivian** Lou Covello Doug Bryan, Aber Resources/Hemisphere Dev. Corp.	The geology of the Sunrise Ag-Zn-Pb massive sulphide deposit, Beaulieu River volcanic belt
2:20	**Larry Aspler** A.R. Miller Terry L. Bursey Can-NWT/MDA	Sedimentology, Structure and Economic Geology of the Poorfish-Windy Thrust-Fold Belt, Ennadai Lake area
2:40	**Steve Goff** GNWT, Can-NWT/MDA	Geology of the Pistol Bay/Whale Cove area - Rankin-Ennadai Greenstone Belt
3:00	**Pat Cavell** Bud Baadsgaard U. of Alberta J.R. Wijbrans Can-NWT/MDA	The Kaminak Lake alkaline complex - a late Archean intrusion in the Rankin-Ennadai greenstone belt
3:50	**Steve Ralser** Adrian Park Can-NWT/MDA	Structure and revised stratigraphy of the Kaminak-Ennadai Belt southwest of Rankin Inlet, Keewatin
4:10	**Ian Thompson** Dejour Mines	The Turquetil gold discovery, Keewatin District
4:30	**J.A. (Al) Donaldson** Carleton U. Can-NWT/MDA	Paleosols and diagenesis of the Thelon Basin

THURSDAY, DECEMBER 8, MORNING SESSION - CHAIR: Mike Cunningham

9:00	**Chris Pedersen** Highwood Resources	Continuing Development of the Thor Lake Rare-Metal deposits
9:20	**Mike Wise** Smithsonian, Wash., D.C., U. of Man. Can-NWT/MDA	Pegmatitie deposits of NWT: Aylmer Lake-Mackay Lake & Chantrey Inlet Pegmatite Fields
9:40	**Chris Hanks** Sub-Arctic Archeologist, GNWT	Cultural Preservation and Resource Extraction

10:20	**Dan Kerr** U. of Alberta NWT Geol. Div.	Late quarternary marine record of the Cape Parry-Clinton Point Region, Mackenzie District
10:40	**Judy Patterson** U. of Toronto Can-NWT/MDA	Preliminary analysis of the Hurtwitz Group, south central Keewatin
11:00	**Dorothy Atkinson** NWT Geol. Div.	Tungsten skarn deposits in the northern Cordillera with particular reference to Mactung
11:20	**W.B. Coker** R.N.W. DiLabio B. Hart, W. Spirito GSC, Can-NWT/MDA	Geochemistry and surficial geology of the Ferguson, Yathkyed and Contwoyto Lakes area

THURSDAY, DECEMBER 8, AFTERNOON SESSION - CHAIR: Mike Wark

1:30	**Ted Batchelor** Treminco Res.	Geology of the Ptarmigan gold quartz veins
1:50	**Andre Lalonde** U. of Ottawa	Magmatic oxidation: causes, manifestations & implications for the gold explorationist
2:10	**Michael Cunningham** Michael Glatiotis Pamorex Minerals Inc.	Geology and structure of the ALGOOD claim area, Regan Lake
2:30	**Jim Kermeen** Athabaska Gold Resources	Nicholas Lake - gold in luecodiorite, a new type of deposit in the Slave Province
2:40	**Bill Padgham** NWT Geol. Div.	NWT Geology programs, proposals and initiatives including the Great Slave Lake Lithoprobe Transect (GSLT)

3:00 Presentations on the Agreement in Principle (AIP) by Dene-Metis and Federal Negotiators who will entertain questions on the impact of AIP on mineral exploration and mining development.
Speakers will include:

Ted Blondin, Chief Negotiator, Dene-Metis Land Claims Secretariat

David Osborn, Chief Negotiator, Dene-Metis Land Claims, DIAND

Chief James Ross, Senior Negotiator, Dene-Metis Land Claims Secretariat

Dan Murphy, Chief Negotiator, Dene-Metis Land Claims, DIAND

FRIDAY, DECEMBER 9, MORNING

8:30 Meeting of the NWT Mineral Exploration Liaison Committee (NWT MELC) in the 8th floor boardroom, Bellanca Building to discuss mineral oriented government geological programs in the NWT.

THE GEOSCIENCE FORUM COMMITTEE
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17TH ANNUAL GEOSCIENCE FORUM
December 5-7, 1989

The 17th Annual Geoscience Forum will be held in the Katimavik Rooms of the Explorer Hotel December 5-7, 1989. Summaries of mineral exploration, geology and mining development will be presented. Industry presentation in geology, mining development and mineral deposits are especially solicited.